A Scranton Gillette Publication

DECEMBER 1961

WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

UNIVERSITY MICROFILMS
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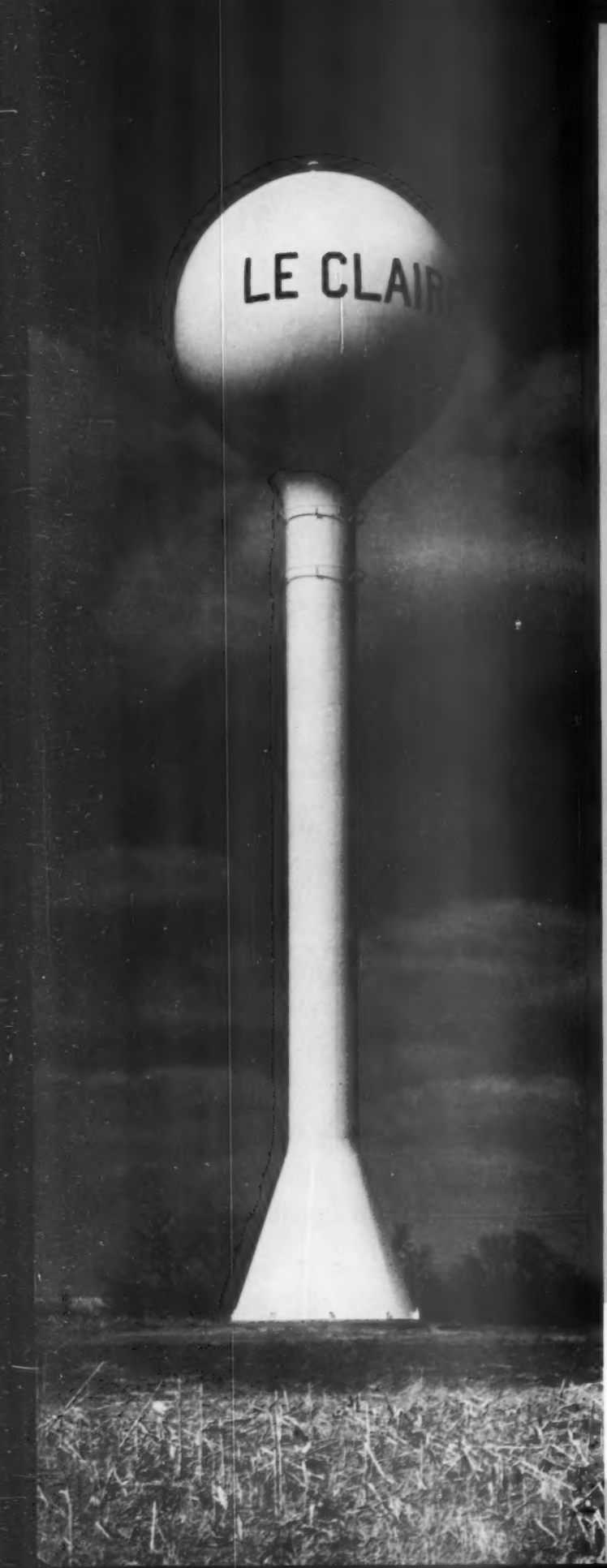
Zukeyama Dam, a 55 ft. earth fill dam which backs up 600 million gallons to supply the island of Okinawa.



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3. The base can be used for pumping and filtering equipment or for storage. Separate costly buildings are not necessary.
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CB&I Waterspheres are ideal for 25,000 to 250,000 gallon storage requirements. CB&I Waterspheroids® are available for requirements ranging from 200,000 to 1,000,000 gallons. Write for Bulletin A-40. Chicago Bridge & Iron Company, 332 S. Michigan Ave., Chicago 4, Ill. Offices and subsidiaries are located throughout the world.

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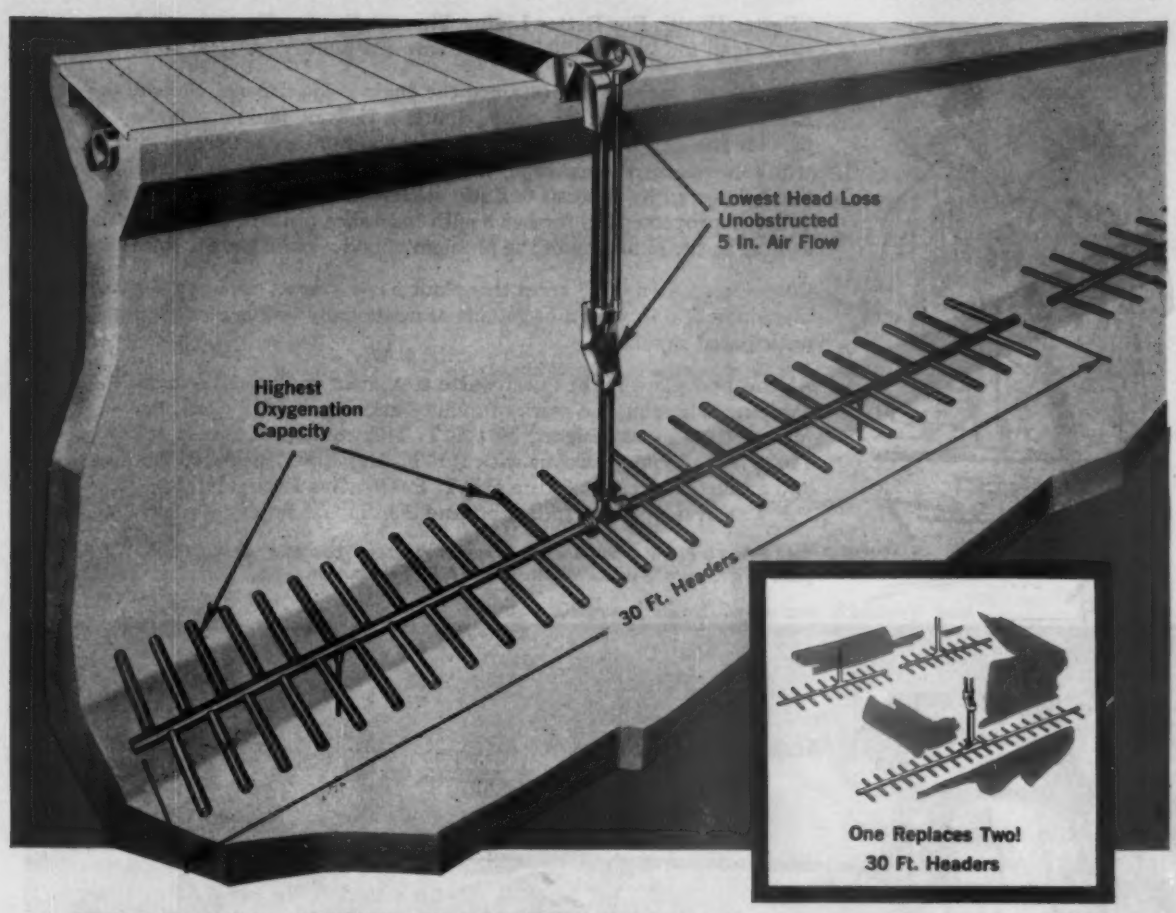
built it!

CB-618

"from Chicago" NEW SWING DIFFUSER...

DESIGNED FOR HIGHER CAPACITIES . . . LOWER COSTS



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Ask for Bulletin No. 179

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WASTE TREATMENT TAKES NO VACATION

at Jacksonville, Florida

"Better Health For Better Living Through Sewage Treatment" is the slogan for Jacksonville's new treatment plant.

The City of Jacksonville retained the engineering firms of Metcalf & Eddy, in Boston, and Reynolds, Smith & Hills of Jacksonville, to provide the city with a Master Plan for the sanitary sewerage requirements for the metropolitan area. This new waste treatment plant designed by Metcalf & Eddy represents more than a 3-million dollar improvement in further health insurance providing the essentials leading to the reduction of the problem of pollution of the St. Johns River.

Covering an area of 45 acres this plant has a present capacity for treating a maximum of 35 millions of gallons of waste daily and is planned for the anticipated expansion.

At this new plant is the finest waste treatment equipment available—equipment bearing the mark of quality and engineering excellence—manufactured and designed by P.F.T. This equipment includes: one 110′ P.F.T. Floating Cover with P.F.T. Aluminum Insulated Roofing and appurtenances for future P.F.T. Pearth Gas Recirculation, P.F.T. Cover Position Indicator, and P.F.T. Gas Safety Equipment.

THE PHOTO *below shows another "Door of Progress" opened by the City's giant step forward in waste treatment with P.F.T. equipment.*

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WATER & SEWAGE WORKS

VOL. 108 NO. 12

DECEMBER 1961

A Scranton Gillette Publication

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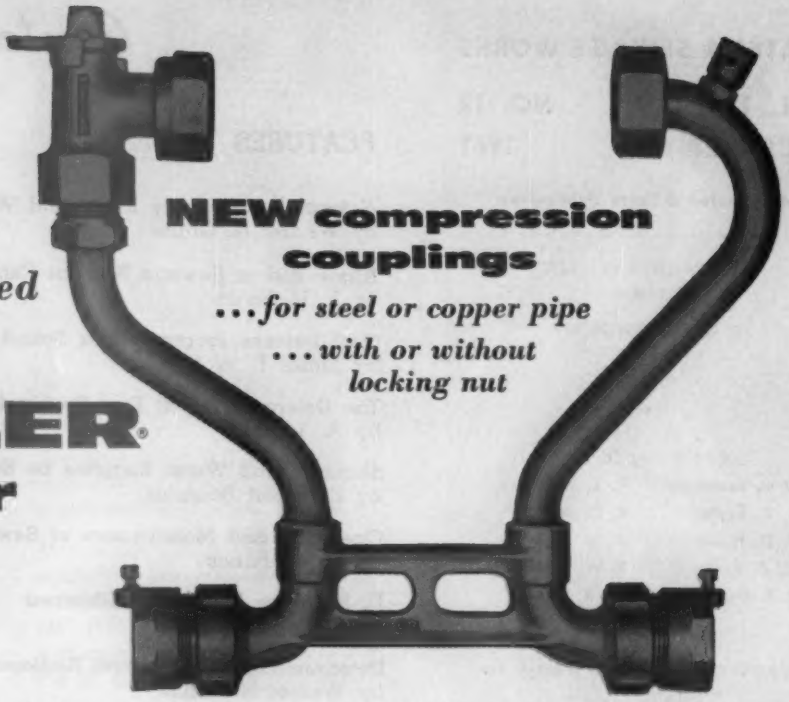

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NEW compression couplings

...for steel or copper pipe

...with or without locking nut

MUELLER® copper meter yokes

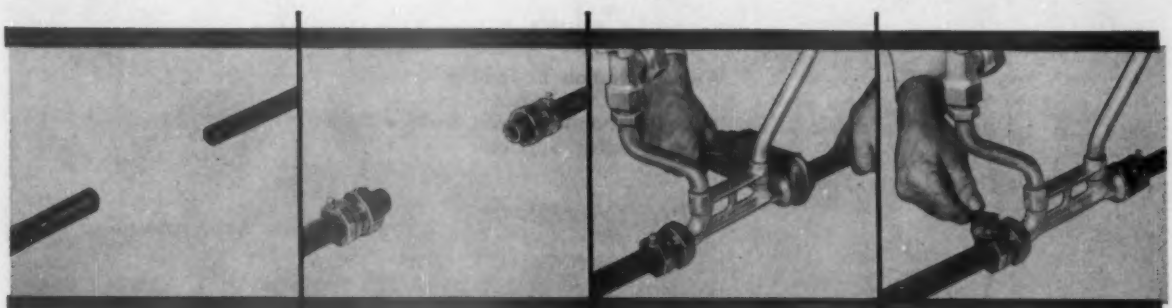
You can now install Mueller Copper Meter Yokes in any existing steel or copper piping in just a few minutes — and without cutting threads or sweating joints.

The simple step-by-step procedure for installing a yoke with Mueller's new Compression Couplings is shown below. Permanent, water-tight joints are quickly made even on rough and badly pitted pipe. Possible trouble is avoided because the piping does not have to be moved.

These new, time-saving couplings are now available for all Mueller Copper Meter Yokes with Multi-Purpose Ends. Regular compression nut or locking nut designs can be furnished for steel or copper pipe.

The locking nut type (shown) positively prevents any movement of the yoke on the pipe and insures continuous electrical bonding of the service piping.

Write for complete information and specifications on Mueller's Copper Meter Yokes.



1 Clean dirt, rust and scale from pipe and cut out a section just slightly longer than yoke (without coupling).

2 Remove all burrs from inside and outside of pipe and slip complete coupling over cleaned ends of pipe.

3 Align yoke between ends of pipe, slide couplings into place and tighten couplings securely onto yoke body.

4 Tighten compression nuts on pipe and lock yoke in place by tightening locking set screw on clamp. Setting complete.

Copper Meter Yokes are just a portion of Mueller's complete line of quality-matched meter setting equipment.

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News—Here & There

Midwest Mercury Products Now in Production

The new Midwest Mercury line of generators, concrete vibrators, and pumps is now in production according to an announcement by W. H. Wilson, President of Wilson Machine Company, Inc.

Midwest Mercury, a division of Wilson Machine, recently acquired the generator, vibrator and pump line from Pacific Mercury. Manufacturing and marketing of their own product line represents a further move in diversification by Wilson Machine Company.

According to Mr. Wilson, no basic product changes have been made other than incorporating the years of experience in precision manufacturing acquired by Wilson Machine Company as a contract manufacturer of aircraft components.

AND Separates ASTM Name

A little word makes a big difference. The American Society for Testing Materials officially changed its name to the American Society for Testing AND Materials Sept. 18 with the signing of a court decree.

The amendment to the Society's Charter was announced by ASTM President Miles N. Clair.

"The inclusion of the word 'and' in the Society's name places added emphasis on the Society's research work in seeking knowledge of the nature of materials," he said. "It is a further reemphasis of one of the basic purposes for which ASTM was founded in 1898."

The change was the result of study and discussion with members throughout the country extending over several years.

"Although a number of other suggestions were given serious consideration," Clair said, "there was strong agreement that there should be a minimum of disturbance of the name. In addition there was unanimous agreement that the initials "ASTM" and the Society's symbol incorporating these initials, recognized throughout the world as the authority for standards for materials, should be unchanged."

ASTM has nearly 11,000 members, including individuals, companies, government and educational institutions. There are also 7,000 engineers and scientists who serve as representatives of company members on the Society's 87 technical committees.

New WPCF Award Presented to Namesake

William J. Orchard was presented a new Water Pollution Control Federation award named after him. President Ray E. Lawrence announced the award at the awards banquet of the October convention held in Milwaukee.

Federation President Ray E. Lawrence presenting to William J. Orchard, the new William J. Orchard award at the 34th annual meeting of the WPCF.

The award for distinguished service was a complete surprise for Orchard. It will be presented to those contributing greatly to the water pollution control future.

During the presentation, Lawrence told of the long association Orchard has had with the profession and the Federation. After graduation, Orchard served with the Metropolitan Water Board in Boston, the Massachusetts Department of Health, and the New Jersey Department of Health.

He began as general manager with Wallace and Tiernan, Inc., Belleville, N. J. in 1915. Until his retirement in 1953 he held many executive posts in the companies.

Orchard is past president of the Water & Sewage Works Mfrs. Assn. and treasurer and director of the American Water Works Assn. He is a fellow in the American Public Health Assn.

The WPCF made him an honorary member in 1946. He has been chairman of the Federation's Finance Committee since 1928.

In 1949 he was awarded the Federation's Charles Alvin Emerson Award for outstanding service in the water pollution field. He has also received the John M. Diven Medal in 1953; the George Warren Fuller award from the AWWA in 1957. He has been named Diplomate in the American Academy of Sanitary Engineers.

Artesian Pressure Down Eighty Feet

The artesian pressure has declined 80 feet in 45 years in San Simon Basin, Ariz., according to an analysis by the Geological Survey.

The survey indicated a multistage aquifer containing the declining water.

Scientists have been cooperating with the Arizona State Land Department to record hydrologic changes taking place in the basin between 1815 and 1960.

During this period, increasing amounts of water have been pumped from ground-water reservoirs as the area grew to become one of Arizona's major irrigated basins.

The entire report is available for reference at the Geological Survey offices. The report is pending publication.

CONTINUED ON PAGE 6A

News—Here & There

Civil Service Deadlines

Competitive examinations for appointment of Sanitary Engineers as officers in the Regular Corps of the U.S. Public Health Service will be held throughout the U.S. on Feb. 13, 14 and 15, 1962.

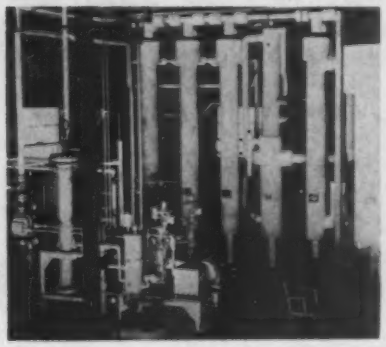
Appointments provide opportunities for career service and research in the sanitary engineering field. Pay rates range from $4,268 to $6,270 per year.

Applications must be received no later than January 5 by the Surgeon General, U.S. Public Health Service (P), Washington 25, D.C.

First "Wet Burning" Plant In Operation

The first commercial system for the "wet burning" of municipal sewage sludge has gone "on stream" in Wausau, Wisc.

Although other installations are in the process of construction throughout the country, Wausau's plant is the first to be officially placed in operation.



The new process bypasses old methods of feeding primary sludge to digesters where solids are filtered off and disposed of over a long period of time.

This system, known as the Zimmermann process, was developed by the Zimmermann Division of Sterling Drug Inc. The process is a method of "burning" organic waste matter while it is suspended in water. Primary sludge is fed directly into the system where it is reduced to a small amount of harmless inorganic ash.

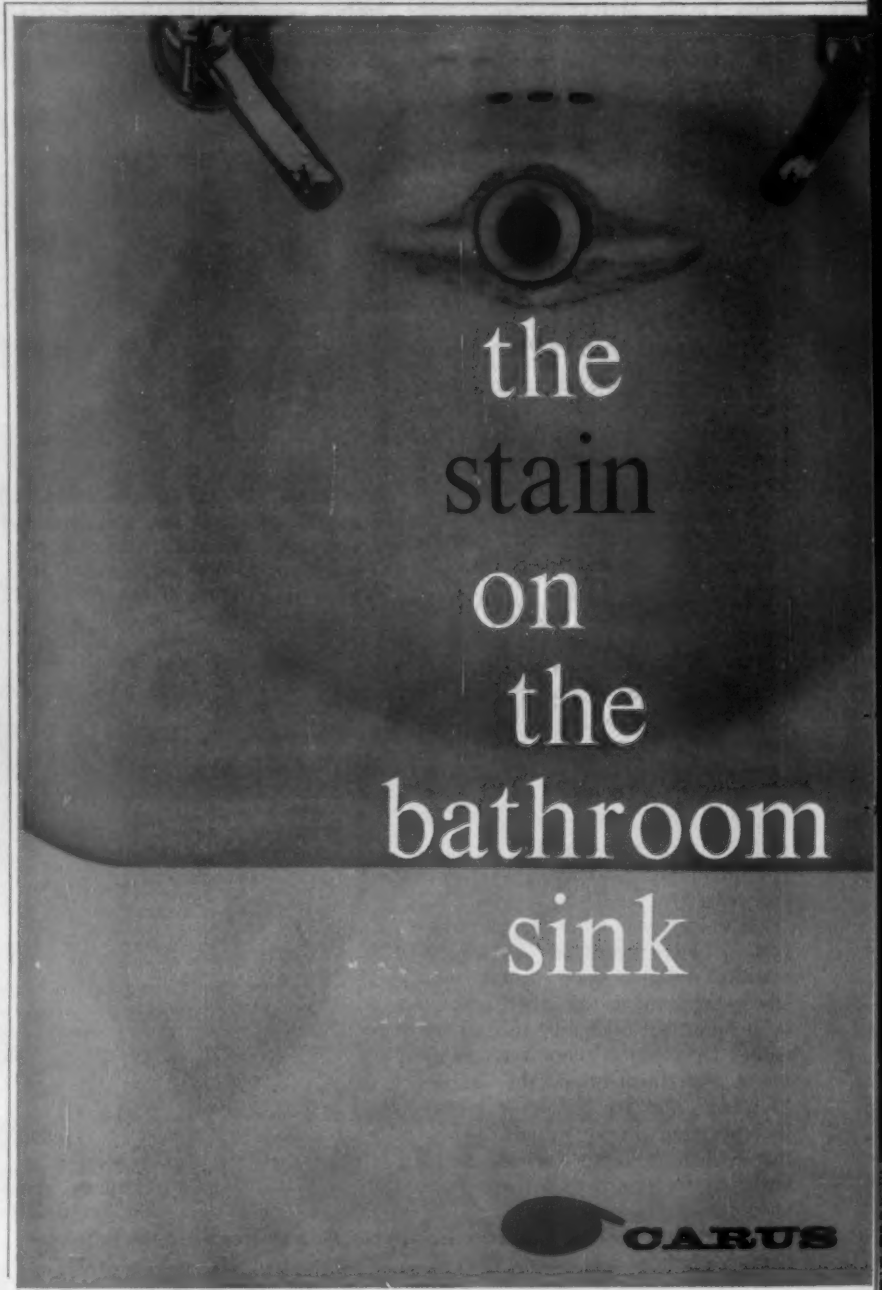
The A. O. Smith Corp. supplied the air receivers, piping, heat exchangers and reactors.

Prime advantages of the Zimmermann process, as seen by the City of Wausau, are that the plant affords ultimate sludge disposal, no odor nor air pollution, no dewatering equipment for evaporation or filtration, operating temperatures are lower and sludge is fed in and ash removed merely by pumping.

Not being bacterial oxidation, the process is not upset by deleterious industrial wastes or retarded by cold weather. In addition, less building area is needed. The Wausau installation occupies only 1200 sq ft.

MSD Hires Finance Director

Del L. Bannister, collector of revenue for St. Louis since 1951, has been appointed director of finance for the Metropolitan Sewer District.



This was announced by Peter Mattei, executive director of MSD.

Mattei said MSD had grown to a point where its collections and expenditures of public tax funds had become too complicated due to the increased number of special benefit assessment tax bills issued, bond issue collections and the taxes assessed for operation and maintenance.

"It therefore became essential, in our opinion, for us to find a man with wide experience in government financial administration to head up the MSD department of finance," Mattei said.

Bannister was first elected collector of revenue in 1950 and took his St. Louis office in March of 1951. He was re-elected for a four-year term in 1954 and again in 1958. His present term expires in 1962.

Portland Water District

The 54th annual report of the Portland Water District, Me., tells that the district continued with construction of extensions of the water mains, the installation of services, meters and fire hydrants.

The district also supplied 6,470,-180,000 gallons of water by gravity from Sebago Lake in 1960. This represented an average of nearly 18 million gallons per day. Water sold by meter was over 3.5 billion gallons.

The district received permission to use the Membrane Filter Method for daily testing after trying the method on their water and demonstrating the need for its use.

Aurora, Ill., Sanitary District Report

The Aurora, Ill., Sanitary District had an unusual year in 1960 with the additions and reconstruction of the administration, clarifier room and screen house buildings practically completed. The first phase of the Interceptor was also more than 75 percent completed and the second leg was in the design stage.

Plans were also nearing completion on the proposed primary and secondary settling tanks, pumping stations, the reconstruction of the digester house building, and the repair of the trickling filter walls and the secondary tank house building.

Even with all of this design and planning going on, the plant processed 3,590,480,000 gallons of sewage. This was about 9.81 million gallons per day. The population served is 75,000 making the average flow per person per day 131 gallons.

Federal Action For Platte River Clean-Up

Federal action to help clean up pollution of the North Platte River from Torrington, Wyo., to Broadwater, Neb., was announced by the Surgeon General of the Public Health Service.

Upon request from the Nebraska Water Pollution Control Council, the Surgeon General called an anti-pollution conference in Scottsbluff, Neb. This is the first step in enforcement procedures under Section eight of the Federal Water Pollution Control Act of 1956, as amended.

The conference covered that portion of the North Platte River from Torrington, about eight river miles from the Nebraska state line—downstream a distance of about 80 river miles to Broadwater.

CONTINUED ON PAGE 8A

is a stain on your reputation
Eliminate iron and
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CAROX*
Potassium Permanganate
Efficient, economical CAROX Potassium Permanganate in your water system can prevent the annoying stains and clogged pipes caused by soluble iron and manganese.
CAROX goes right to work (in your present equipment), converting all of the dissolved iron and/or manganese to the corresponding insoluble oxides . . . which can then be readily removed by coagulation, sedimentation, and/or filtration.
You'll find that CAROX works rapidly, economically, and effectively, to improve the quality of your water . . . and your community's reputation. If you have problems with iron and manganese, write today to Carus Chemical Company, Inc., 1377 Eighth Street, La Salle, Illinois, for a free copy of our illustrated brochure, "CAROX Potassium Permanganate for Quality Water."
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News Here and There

CONTINUED FROM PAGE 7A

Farmers Get City Water Through A Plastic "Straw"

In Longmont, Colo., 152 farmsteads are getting "city" water for the first time through a plastic pipeline.

Trucks transported water to each farm before the Longs Peak Water Association was organized. Now a 26-mg earth-fill reservoir and pipeline supplies water from mountain sources to farms covering 24 sq mi.

B. F. Goodrich Industrial Products Co. shipped 28 miles of Koroseal rigid plastic pipe to Longmont on five railroad cars from Marietta, Ohio. Special end-opening cars were needed to carry the 40-ft long sections of pipe.

The new water system, using 149,799 ft of the pipe and more than 3,800 Koroseal couplings and flanges, is one of the longest rural installations to date to use plastic pipe.

Engineers who designed the system recommended plastic pipe because the alkaline condition of the soil in this area causes electrolytic action that corrodes metal pipe and greatly reduces its service life. The Koroseal pipe is expected to outlast standard metal pipe in this service by at least five times.

The installation time for plastic pipe has proved to be much shorter than metal due to its light weight and coupling method. The 40-ft sections were coupled with a quick-drying liquid solvent. The connections form a permanent water-tight weld.

Eight diameters of pipe were used —starting with 8-in. at the reservoir and graduating down to 1-in. leading into the house and barn. Pipe and fittings represent only a small portion of the cost of the water distribution project. The complete system is estimated at about $280,000.

Chicago Heights Sanitation Report

The 33rd annual report of the Sanitary District of Bloom Township Chicago Heights, Ill., presents a colorful and pictorial report of the progress made by the district.

A big step reported by the superintendent is the annexation of 40.459 acres to the district. This annexation lead to the formulation of a Future Planning Program which has been initiated by the district.

The Bloom District also will begin operation and experimentation on an oxidation ditch within the next two years. In addition, an architect was contacted to design a modern warehouse and garage building.

Potato Chip Waste Book Available

The "Disposal of Potato Chip Waste by Anaerobic Digestion," a bulletin published by the Washington State Institute of Technology, is available free of charge from the office of Technical Extension Services, Division of Industrial Research, Washington State University, Pullman, Washington.

Crystal-clear water... and every drop free of germs, algae, and fungi. HTH releases effective, dependable chlorine that sanitizes new pipe lines, protects wells and reservoirs, too. Comes in either free-flowing granular or convenient tablet form. Packed in new, easy-to-handle 3¼-lb. plastic bottles, 35-lb. pails and 100-lb. metal drums. Write for literature, to: OLIN MATHIESON, Baltimore 3, Md.

Here's to Health... **HTH**®

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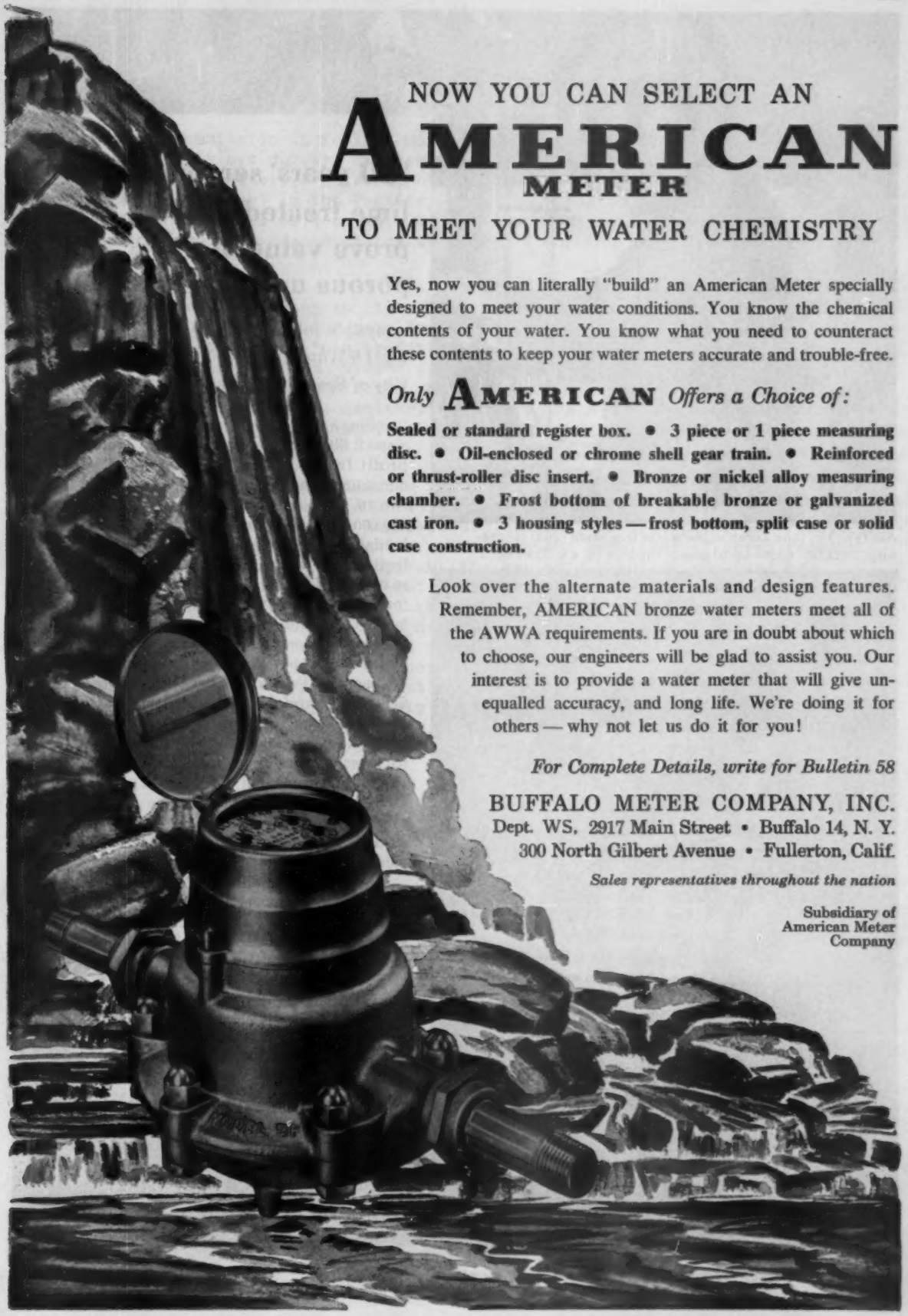

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AMERICAN METER

TO MEET YOUR WATER CHEMISTRY

Yes, now you can literally "build" an American Meter specially designed to meet your water conditions. You know the chemical contents of your water. You know what you need to counteract these contents to keep your water meters accurate and trouble-free.

Only AMERICAN *Offers a Choice of:*

Sealed or standard register box. • 3 piece or 1 piece measuring disc. • Oil-enclosed or chrome shell gear train. • Reinforced or thrust-roller disc insert. • Bronze or nickel alloy measuring chamber. • Frost bottom of breakable bronze or galvanized cast iron. • 3 housing styles — frost bottom, split case or solid case construction.

Look over the alternate materials and design features. Remember, AMERICAN bronze water meters meet all of the AWWA requirements. If you are in doubt about which to choose, our engineers will be glad to assist you. Our interest is to provide a water meter that will give unequalled accuracy, and long life. We're doing it for others — why not let us do it for you!

For Complete Details, write for Bulletin 58

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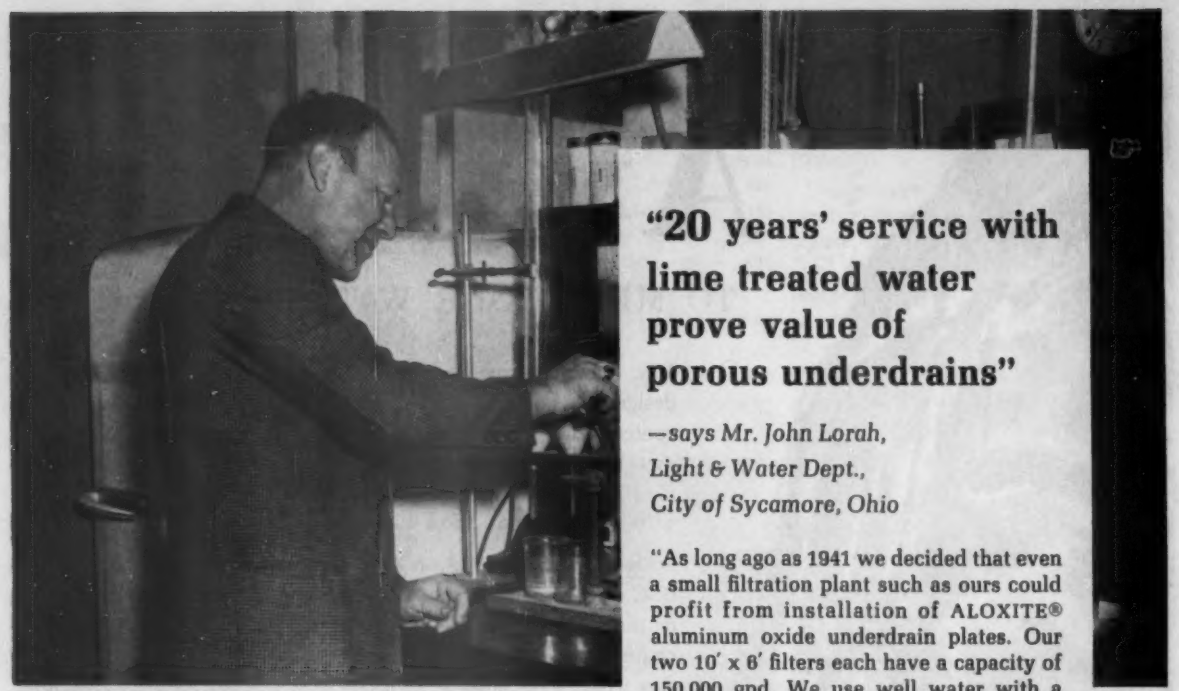
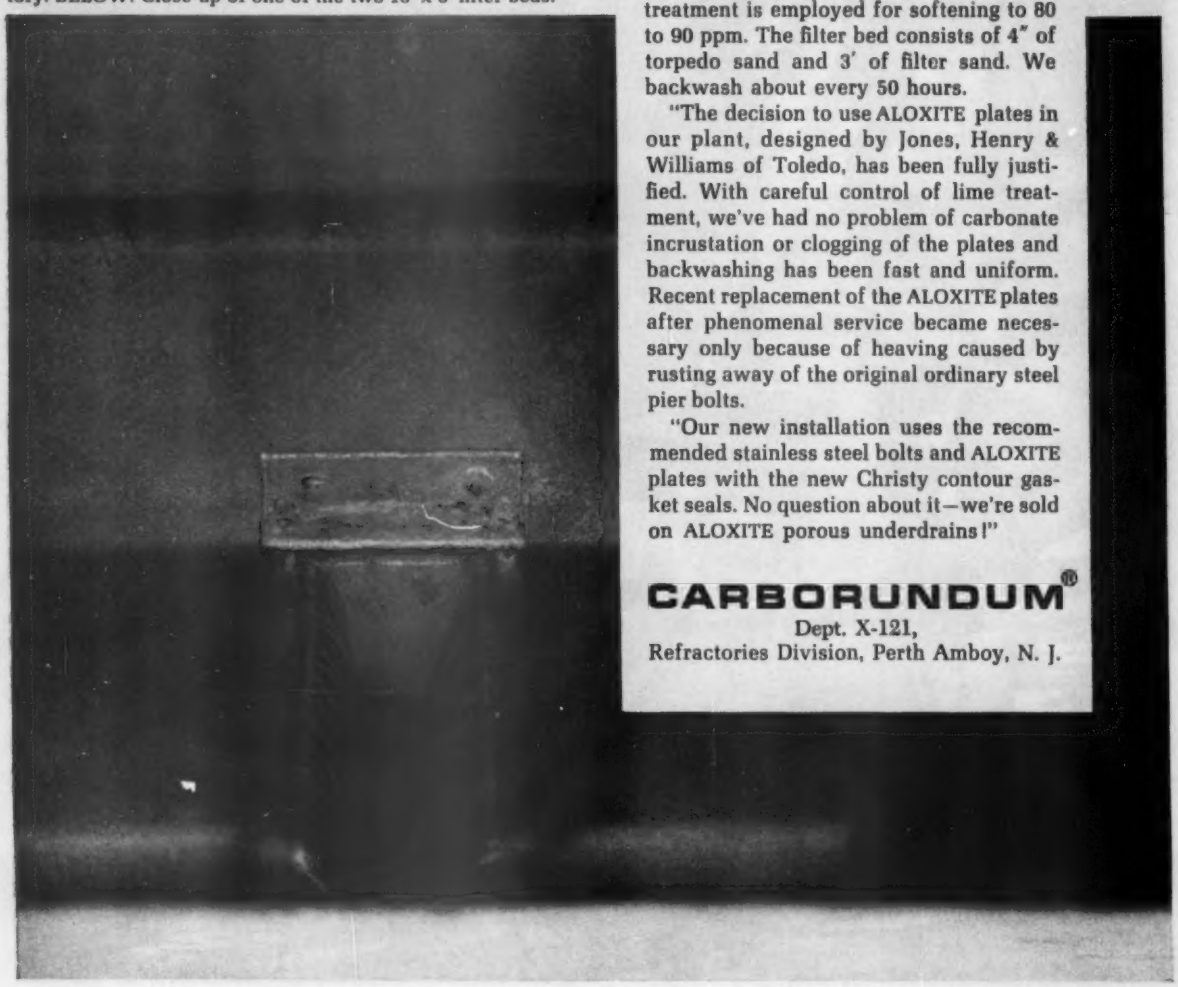


ABOVE: Mr. John Lorah in the water treatment plant laboratory. BELOW: Close-up of one of the two 10′ x 6′ filter beds.



"20 years' service with lime treated water prove value of porous underdrains"

—says Mr. John Lorah,
Light & Water Dept.,
City of Sycamore, Ohio

"As long ago as 1941 we decided that even a small filtration plant such as ours could profit from installation of ALOXITE® aluminum oxide underdrain plates. Our two 10′ x 6′ filters each have a capacity of 150,000 gpd. We use well water with a hardness of approximately 650 ppm. Lime treatment is employed for softening to 80 to 90 ppm. The filter bed consists of 4″ of torpedo sand and 3′ of filter sand. We backwash about every 50 hours.

"The decision to use ALOXITE plates in our plant, designed by Jones, Henry & Williams of Toledo, has been fully justified. With careful control of lime treatment, we've had no problem of carbonate incrustation or clogging of the plates and backwashing has been fast and uniform. Recent replacement of the ALOXITE plates after phenomenal service became necessary only because of heaving caused by rusting away of the original ordinary steel pier bolts.

"Our new installation uses the recommended stainless steel bolts and ALOXITE plates with the new Christy contour gasket seals. No question about it—we're sold on ALOXITE porous underdrains!"

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Dept. X-121,
Refractories Division, Perth Amboy, N. J.

Washington Viewpoint

Atomic Energy Commission is feeling more confident of its radioactive waste sea-disposal program, as new surveys are completed. Latest is a survey which indicates "no detectable radioactivity" attributable to disposal operations at two deep-sea sites (6,000 ft of water) in the Pacific, near the Farallon Islands and in the Santa Cruz Basin. A total of some 25,000 packages, containing 14,060 curies of radioactivity, have been dumped at the two sites since the Farallon area was first used in 1946.

* * * * * * *

Federal government will step up its competition for trained technical personnel—through requests to Congress for more "supergrade" ($18,000 and over) civil service posts; establishment of more "non profit" corporations to do research and development work, and other devices. Demand is very largely in scientific fields connected with space and military efforts, but is certain to raise the "going" price for most engineering employees. Sanitary engineers are a target, however, because of dangers of air and water pollution from nuclear warfare.

* * * * * * *

Public health service has put its new $300,000 air-monitoring program into operation, to check pollution levels in urban centers. Eight major central-city areas—Chicago, Cincinnati, Detroit, Los Angeles, New Orleans, Philadelphia, San Francisco and Washington—will provide automatic and continuous samplings of seven gaseous pollutants. The new program won't supplant the periodic sampling provided by PHS' National Air Sampling Network—but will obtain more sharply defined information from urban centers for research into health effects of air pollution.

Cuts in government spending programs next year—in view of a frightening $7 billion deficit due for the current fiscal year—aren't likely to disturb programs of interest to sanitary engineers and contractors. First announced cut in Health, Education & Welfare department, for instance, will save some $102 million—but it will be done by not filling 627 newly authorized jobs, and some cutbacks in educational and other programs. There'll be no cut in the program of promoting construction of pollution-abatement plants, for example—Congress has already set up spending.

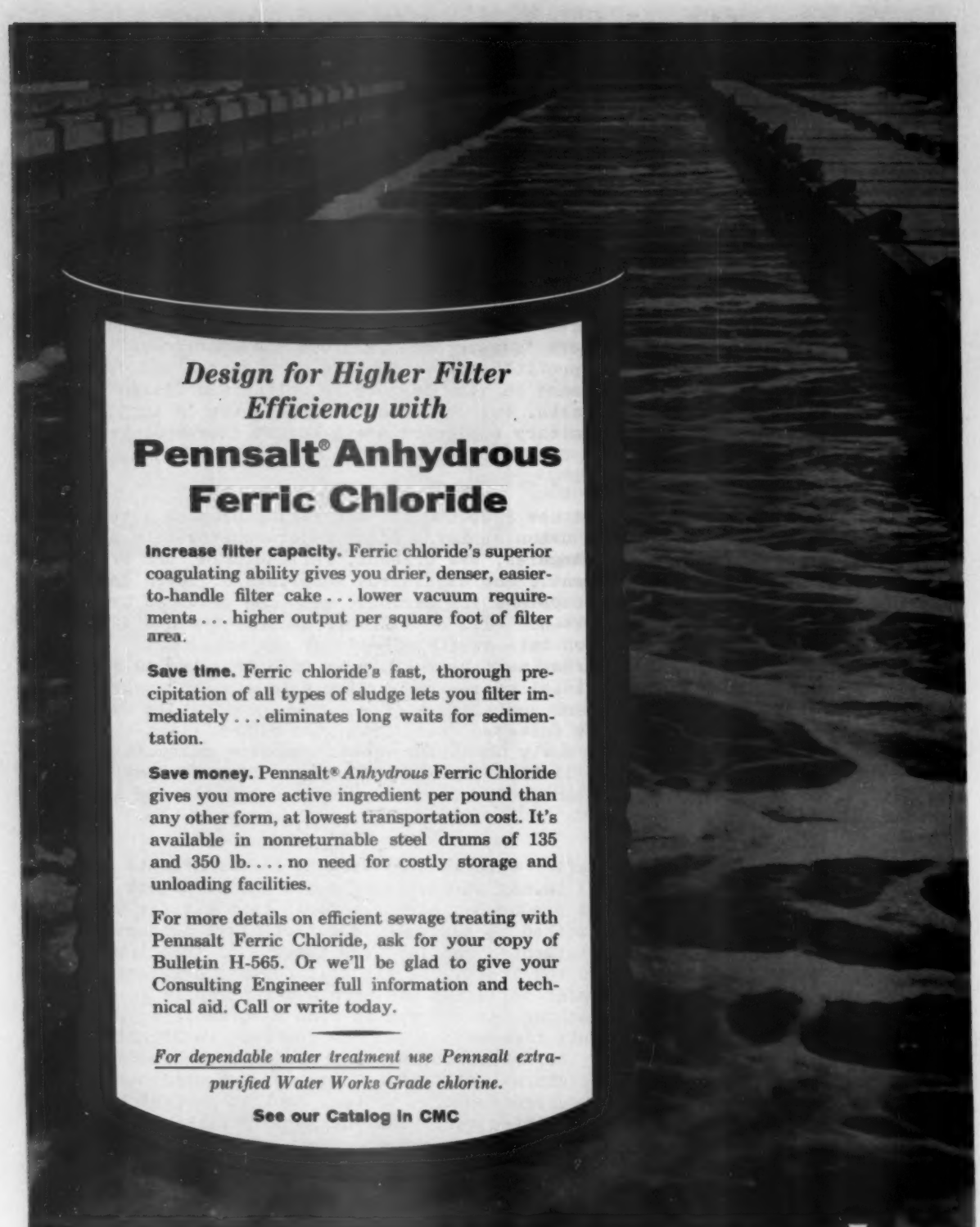
* * * * * * *

Federal Housing Administration (after experimental work at Michigan State Health Department laboratories at Lansing) thinks it has found a new way to detect detergents in water supplies, and has produced a portable field test kit for the purpose (designated as TS 4.45). The method is designed to detect alkyl benzene sulfonate molecules, present in detergents, and involves the use of tolodine blue dye, instead of methlyn blue dye in the tests. The kit will be made available to FHA field offices in areas where detergent pollution has been a water supply problem.

The Maritime Administration is pushing its program to find a workable shipboard oil and water separation system—this time with a $53,000 contract to Pfaudler Permutit, Inc., of Rochester, N.Y., for research. First phase will be laboratory work looking into oil-water mixture characteristics and separation techniques; second phase will be construction and test operation of a system. Work is part of the U.S. participation in the recently-ratified world convention on pollution of the seas by oil, as well as an effort to improve waters of rivers and lakes that may be fouled by shipping operations.

* * * * * * *

It's interesting that the first technical assistance project to be approved by the new Area Redevelopment Administration involves water supply—a $45,000 grant to the Corps of Engineers for a study of a proposed industrial reservoir at Rend Lake in southern Illinois (Franklin and Jefferson counties) where adequate water supplies are believed the key to industrial expansion. And a second major grant from ARA also went into the area of interest of W&SW readers: A $106,300 public facilities loan and grant for a new water and sewer system to serve a new industrial park at Mountain City, Tenn.



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Pennsalt® Anhydrous Ferric Chloride

Increase filter capacity. Ferric chloride's superior coagulating ability gives you drier, denser, easier-to-handle filter cake . . . lower vacuum requirements . . . higher output per square foot of filter area.

Save time. Ferric chloride's fast, thorough precipitation of all types of sludge lets you filter immediately . . . eliminates long waits for sedimentation.

Save money. Pennsalt® *Anhydrous* Ferric Chloride gives you more active ingredient per pound than any other form, at lowest transportation cost. It's available in nonreturnable steel drums of 135 and 350 lb. . . . no need for costly storage and unloading facilities.

For more details on efficient sewage treating with Pennsalt Ferric Chloride, ask for your copy of Bulletin H-565. Or we'll be glad to give your Consulting Engineer full information and technical aid. Call or write today.

For dependable water treatment use Pennsalt extra-purified Water Works Grade chlorine.

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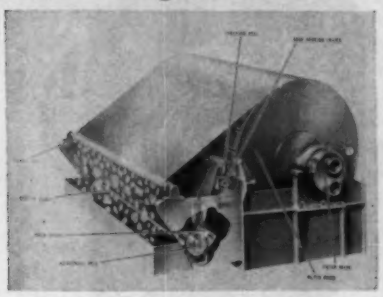
EQUIPMENT IN THE NEWS

For further information on products or services please use reader service card.

New D-O Belt Filter Uses Proven Design Elements



A new belt filter design, which finally solves the related problems of smooth application of the medium to the filter drum and uniform and controlled belt tracking, has been introduced in a full range of sizes and materials by Dorr-Oliver Incorporated.

Known as the D-O Webtrol Filter, the new unit applies dependable web tracking control and web spreading equipment to a new version of the basic Oliver vacuum drum filter design. A bowed roll spreads and smooths the fabric, holding the medium flat against the filter drum under uniform tension.

The Webtrol Filter is particularly applicable to slurries which tend to blind the cloth, and to operations where a sufficiently high filtrate clarity cannot be obtained with the usual types of vacuum drum filters.—Dorr-Oliver Inc.

Circle No. 1201 on Reader Service Card

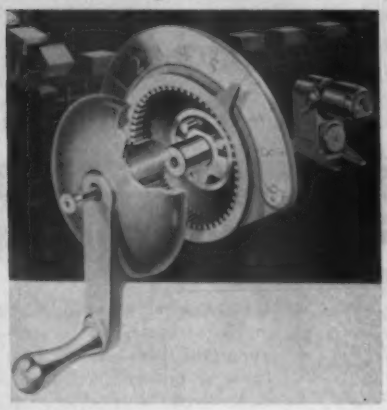
Positive Displacement Chlorinator

This manufacturer has developed a positive displacement type automatic chlorinator, the Everclor, Model PD. This chemical feedpump has a standard capacity of ten gallons of full strength hypochlorite solution in a 24-hour period with a maximum pumping pressure of one hundred pounds per square inch. An optional model is available to deliver as much as 30 gallons a day.

A finger-tip control makes it simple to adjust the Everclor for uniform feeding from zero to one hundred percent.—Everpure, Inc.

Circle No. 1202 on Reader Service Card

Varidrive Speed-Lock

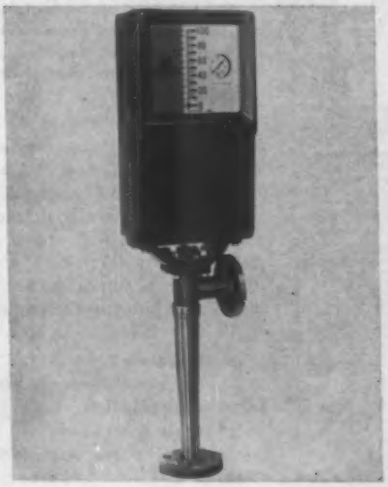


A new, patented self-locking speed control is being offered as standard equipment on integral h.p. U. S. Varidrive Motors. The new control assures that any rpm setting will be maintained without "drifting" or "creeping" until the operator chooses to change speeds.

Cam and rollers are so arranged as to lock the speed-changing mechanism until force is applied to the handle.—U. S. Electrical Motors Inc.

Circle No. 1203 on Reader Service Card

Rotameter Transmitter Has Powerful Servo System and Plug-in Components



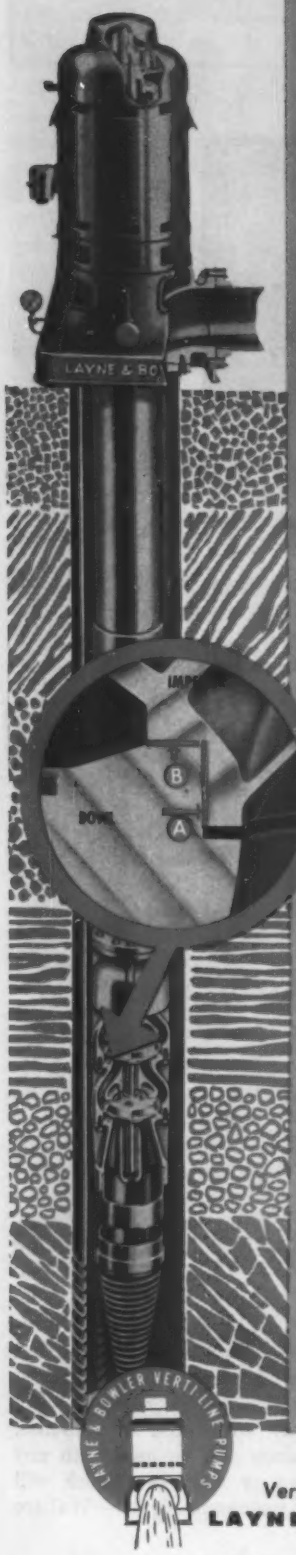
The new Wallace and Tiernan Pneumatic Varea-meter Transmitter has a powerful servo system, plug-in components and other unique design features which give improved operation and added reliability. It is designed specifically for use with W & T Metaltube and Glass-tube Varea-meters.

The float-position sensing device is positioned over the entire float travel by a powerful pneumatic servo system. This design gives more positive indication of float position and improves accuracy, sensitivity and speed of response.

The Varea-meter Transmitter can be used with any indicator, recorder, integrator or controller which will accept a standard 3 to 15 psi pneumatic signal.—Wallace & Tiernan Inc.

Circle No. 1204 on Reader Service Card

CONTINUED ON PAGE 14A



Still Another Reason You're Far Ahead With...

Verti-Line Pumps

Unique "PERIHEDRAL" 2-WAY Pump Seal ASSURES GREATER OPERATING EFFICIENCY!

If you think all vertical turbine pumps are pretty much the same, you haven't investigated the important "plus" advantages built into every Layne & Bowler "Verti-Line" Pump. Tougher, longer-lived "Moly" Iron *at no extra cost to you* is one vital "Verti-Line" advantage. Another is the larger-than-standard pump shafting in "Verti-Line" Pumps for greater resistance to costly "twist-offs."

And still another is the unique "Perihedral" Pump Seal found only in Verti-Line Pumps. This seal combines both *vertical* and *horizontal* sealing surfaces between each pump bowl and its impeller.

The vertical sealing surface "A" permits shaft stretch under load without losing the pump seal.

The horizontal sealing surface "B" permits accurate adjustment *at ground level* to compensate for wear. Saves time, simplifies maintenance, assures full operating efficiency without complicated adjustments!

Vertical Turbine pumps are the ideal solution to a wide range of modern pumping problems because they save costly floor space, require no priming, are generally simpler to install. But don't be satisfied with *ordinary* vertical turbine pumps. Specify "Verti-Line" Pumps and get the half-century of vertical turbine pump know-how that is built into *every* Layne & Bowler unit.

Want More Data? "Verti-Line" Pumps are available in a complete range of sizes to fit all types of industrial applications, from deep-well primary water supply to close-coupled booster or waste disposal applications. Also, laboratory-approved "Verti-Line" Fire Pumps are available for municipal and industrial fire protection. Tell us the type of pump you need and we'll send literature that describes the *extra* advantages you get in "Verti-Line" equipment.

Verti-Line Pumps are the exclusive products of

LAYNE & BOWLER PUMP COMPANY
LOS ANGELES 22

New York 20, N.Y. • Chicago 4, Ill. • Hastings, Neb. • Monroe, La.
Farwell, Texas • Twin Falls, Idaho • Fresno, Calif.

Equipment News

CONTINUED FROM PAGE 13A

ATC Timer is Available With Bezel Mounting

The new Atcotrol 305B Automatic Reset Dial Timer is available with a Bezel Mounting for those installations which require a flush-mounting.

Four bevel headed screws anchor the bezel mounting to control panel. Like all other ATC mountings, it is shock and vibration resistant. This new mounting is made of cast aluminum and may be optionally equipped with a knob locking device for protection against unauthorized dial setting changes.—Automatic Timing & Controls, Inc.

Circle No. 1205 on Reader Service Card

Chemical Compound

To increase the capacity of overloaded sewage systems, this manufacturer has developed Chem-Zyme II, a balanced compound consisting of enzymes, aerobic and anerobic bacteria.

Chem-Zyme II helps to digest carbohydrates, fats and other proteins and contains an organism that forms a thin layer on the tank surface to exclude air and permit aerobic bacteria to grow.

Chem-Zyme II corrects digester troubles, eliminates the grease problem, eliminates offensive sludge odors, keeps sewage lines and lift stations open, reduces scum, digests and liquifies all normal sewage wastes and solids to end costly sewage disposal problems.—National Chemsearch Corp.

Circle No. 1206 on Reader Service Card

New Filtration Medium

TEFLON felts are now being produced for the specialized filtration needs of industry. American Felt Company is now manufacturing TEFLON filter felts in widths up to 72 in., in lengths up to 60 yds., and in thicknesses of 1/16 in., ⅛ in. and ¼ in.

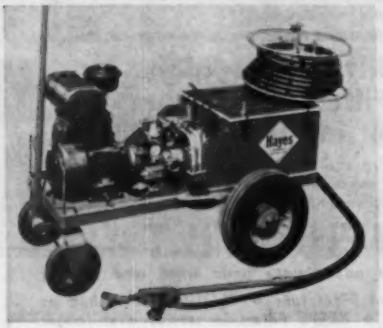
The TFE-fluorocarbon resins from which felt fibers are made consist of two elements, carbon and fluorine. As with other crystalline plastic fibers, the molecules are bound tightly together in orderly fashion. This results in exceptional heat and chemical resistance—two of the most valuable characteristics of the new TEFLON fiber felts.

This same close molecular structure helps give TEFLON another unique charactristic—felts made from these fibers repel other materials. Because few materials stick to felts made of TEFLON fibers, these new felts are easily cleaned by reverse pressure or by washing.—American Felt Co.

Circle No. 1207 on Reader Service Card

New Type of Power Sprayer

This manufacturer has just announced a new portable and compact all-purpose heavy duty power sprayer —The Hayes Jet 500—based on an entirely new principle in the power sprayer field. Patents are pending.



Intended to serve many kinds of purposes in highly diversified industrial and commercial fields, it is scientifically designed to give high efficiency, reduce labor costs and provide a broad range of spray applications, using any type of chemical, detergents, cleaning compounds or sanitizing chemicals—liquid or soluble.

It provides a new, fast and efficient method for high-pressure maintenance cleaning of manufacturing plants, machine shops, heavy metal fabricating equipment, warehouses, loading docks, fleet trucks, earth moving and highway building equipment, building exteriors, cement floors, driveways, etc. —Hayes Spray Gun Co.

Circle No. 1208 on Reader Service Card

New Line of Gas Powered Diaphragm Pumps

A new line of gas engine powered. diaphragm pumps includes both single and double diaphragm types in an over-all range of fourteen model sizes.

Also many models available with air-cooled diesel power. Capacities range from 1,000 to 17,000 gph. Suction and discharge openings range from 2 in. single on the new Model 2D-8 to 4 in. double on the 24D. Both swing and ball type valves are offered in the new line. The pump's worm gear drive provides a one-step speed reduction, eliminating any need for an intermediate speed reduction on either the power source or the pump. Worm and worm gear operate in a constant bath of oil.—Rice Pump & Machine Co.

Circle No. 1209 on Reader Service Card

Space-Saving, Silent Submersible Pump

FloWay submersible pumps, a new line for underground installation where space is limited, silence required, or booster service needed, is announced by this manufacturer.

These submersibles can be installed in any depth well. Waterproof motor and multi-stage bowl unit are close coupled and sit at the end of the pipe column, submerged in fluid, thus eliminating pumping sounds and noise complaints from residential area installations. They also can be used for booster service, cut into the flow line almost anywhere, underground and out of the way, in either a vertical or horizontal position. Thus they can be installed under streets, park areas, or floors where pump houses are impractical, unsightly, or floor space lacking.

Sizes range from 25 to 300 hp, at 1750 & 3600 rpm, 100 to 4000 gpm, and 0 to 1000 psi for handling almost all fluids—viscous or non-viscous, corrosive or non-corrosive. —Fiese & Firstenberger Mfg., Inc.

Circle No. 1210 on Reader Service Card

New Versatile Timer Control

New electronic "Protectal" Timer, developed by this manufacturer, provides separate adjustable time-ON and time-OFF intervals for actuating continuous process equipment and systems.

Outstanding characteristics is its flexibility. Has just two simple adjustments for predetermined time intervals: ON—from 1/16 to 5 seconds; OFF—from 1/16 to 30 seconds. A step switch consecutively energizes up to 24 external circuits for a wide range of precise pulsing operations, such as, on/off valve operation, dust collector timing, life testing of new equipment, and other applications where continuous, reliable operation is required, and especially where separate ON and OFF time intervals are important.

Design incorporates a single life-tested electronic tube, rated for millions of operations. For 115 volt 60 cycle operation. Open type chassis available for panel mounting.—Protection Controls, Inc.

Circle No. 1211 on Reader Service Card

CONTINUED ON PAGE 16A

Equipment News

CONTINUED FROM PAGE 15A

New Corrosion-Resistant Materials for Fischer & Porter dp Transmitters

Several new options in corrosion-resistant materials for construction of the process-wetted parts of Series 10B1460 dp Transmitters have been announced by Fischer & Porter Company.

The new options include Hastelloy C, Monel, Tantalum, and Teflon. Various combinations of these materials are available in all models of dp Transmitters. These instruments have ranges, in inches of water, of 0-20 to 0-200, 0-30 to 0-300 and 0-100 to 0-1000.—Fischer & Porter Co.

Circle No. 1212 on Reader Service Card

Plastic Coated Tapes

The B. G. Reilly Co., of North Scituate, R. I., distributors of Chesterman measuring tapes, announces the availability of the new plastic coated metallic and non-metallic tapes manufactured by James Chesterman & Co., Ltd., of Sheffield, England.

The new tapes are made in lengths of 25, 50, 100, 150 and 200 feet and are available with graduations either in 10th or 12th.

An important feature is a three-foot heavy plastic tongue at the end of the tapes to protect this vulnerable part of the tape from abrasion and wear. Chesterman tapes are waterproof, crease-resistant and easily cleaned because of the new plastic coating used for the full length of its tapes.—B. G. Reilly Co.

Circle No. 1213 on Reader Service Card

Compact, Low-Cost Temperature Potentiometers

Three new, low-cost, portable potentiometers have been announced by this manufacturer. These instruments provide on-the-spot measurements of temperature for instrument maintenance departments, and in testing and research work.

The 8694 Single-Range and the 8695 Double-Range Temperature Potentiometers indicate temperatures directly in degrees F in any of 15 temperature ranges. The 8696 Double-Range Millivolt Potentiometer is calibrated for emf measurements on two ranges, 0 to 22 and 20 to 64 . . . has a manual reference junction compensation dial and can be used as a

source of calibrated voltage for checking other potentiometer-type instruments.—Leeds & Northrup Co.

Circle No. 1214 on Reader Service Card

CONTINUED ON PAGE 20A

SPEED SENSITIVE SWITCHES

All GH series of cable driven governors and switches are available in this GH-E series. This housing meets the specifications for class 1 group D, Explosion Proof Equipment. For further information, write for Bulletin 504-A.

SYNCHRO-START PRODUCTS, INC.

8151 N. RIDGEWAY AVE. SKOKIE, ILLINOIS

No other filtering medium compares with

ANTHRAFILT

Trade Mark Reg. U. S. Pat. Off.

Anthrafilt stands alone as the one Filtering Medium that is best for all types of filters.

Years of efficient and economical use in every type of filter plant has made ANTHRAFILT the standard of excellence in the filtering medium field.

ANTHRAFILT

offers important advantages over sand and quarts

DOUBLES length of Filter runs • REQUIRES only half as much wash water. • KEEPS Filters in service over longer periods. • INCREASES Filter output with better quality effluent. • GIVES better support to synthetic resins. • PROVIDES better removal of fibrous materials, bacteria, micro-organic matter, taste, odor, etc. • IDEAL for industrial acid and alkaline solutions. • EFFECTIVE filtration from entire bed. • LESS coating, caking or balling with mud, lime, iron, or manganese.

IDEAL FOR USE IN EVERY TYPE OF FILTER

Write for further information, test samples and quotations to:

PALMER FILTER EQUIPMENT CO.

P. O. Box 1696 — 822 E. 8th St., Erie, Pa.

Representing:

ANTHRACITE EQUIPMENT CORP.

Anthracite Institute Bldg., Wilkes-Barre, Pa.

LAYING PIPE UNDER WATER was the tough assignment of Lloyd Kispert & Son, contractors of Green Bay, Wisconsin, at the town of Preble, Wisconsin.

Below the water table...water-tight joints

Lloyd Kispert & Son recently laid 3611 feet of 12-inch K&M Asbestos-Cement Sewer Pipe within a few hundred feet of Green Bay. The water table was so high that the pipe was laid under water. Nevertheless, all joints had to be infiltration-tight. On the next page, Mr. Kispert, in his own words, tells how he solved this problem.

You can dig flatter grades for K&M Asbestos-Cement Sewer Pipe because its bore remains smooth and clean.

Water, snow, mud, and rain can't hold up the installation of K&M Asbestos-Cement Sewer Pipe.

"K&M ASBESTOS-CEMENT GRAVITY SEWER PIPE GAVE US PERMANENTLY TIGHT JOINTS IN WET GOING!"

"This was an extremely rough job. But, with K&M Pipe, we got tight joints in wet going. The K&M FLUID-TITE® Coupling connected easily, even under water. The men just had to lubricate the tapered end of the pipe and slide it into the coupling. We didn't need any heavyweight coupling pullers. Our men had an easy time handling the pipe because of its light weight. We are very satisfied with K&M Pipe and will use it again."

Mr. Lloyd Kispert

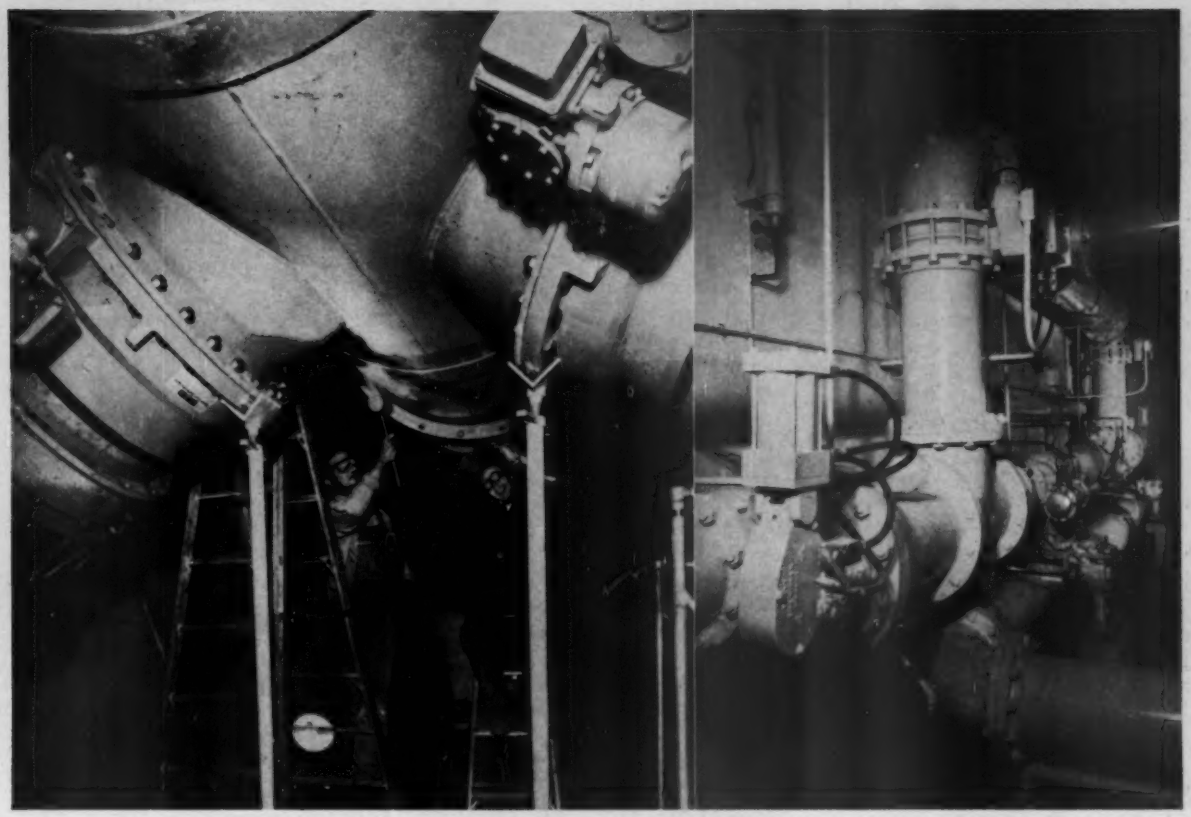
You could lay K&M Asbestos-Cement Sewer Pipe at the bottom of a 58′ deep lake, and it would be infiltration-tight.

The smooth bore of this modern pipe remains clean, permanently. The friction coefficient is low. You can plan fewer lift stations and flatter grades.

K·M

Keasbey & Mattison at Ambler

For more information on this top-quality gravity sewer pipe, write to: Keasbey & Mattison Company, Ambler, Pa.

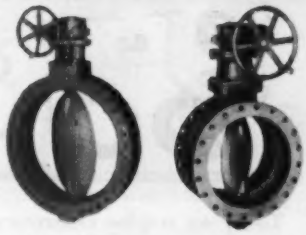


IN LARGE SYSTEMS or SMALL SYSTEMS...

You can use bubble tight Henry Pratt Valves

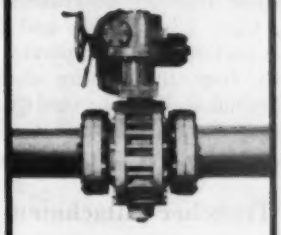
Chicago and Western Springs are only 14 miles apart—Chicago has the world's largest filtration plant—Western Springs has a typical small city station—Henry Pratt Company supplied butterfly valves for both—different types of butterfly valves to be sure, but each ideally suited to its job requirements.

Few valve manufacturers can offer this range of valve sizes—none can offer a wider or deeper experience in valve design and application. When you are specifying valves—call in a Henry Pratt engineer; his experience and the company's range of products will help you make a wise, economical choice.



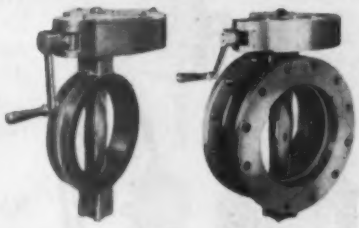
Anvil Seat Butterfly Valves, 24" and up

For 25-8 thru 50-16 in narrow face-to-face and 50-8 thru 125-16 in wide face-to-face. Thoroughly proven in filter plant, pump discharge and distribution service under maximum pressures and velocities. Seat is adjustable and replaceable for continuous bubble tight service. **Catalog B-3B**



Ball Valve

The first proven rubber seated ball valve is ideal for pump check service or high pressure distribution lines. Features new Pratt Rolo-Link cylinder operator. **Catalog BA-1B**



Monoflange and 2F II Valves, 3" thru 20"

For pressures to 150 pounds, ideal for small plants or secondary distribution. Monoflange is a "wafer" type with rubber seat acting as the gasket. 2F II is flanged model. Complete range of operators. Structurally A.W.W.A. 125-16. **Catalog B-11B**

HENRY PRATT®

Creative Engineering for Fluid Systems

HENRY PRATT COMPANY
319 W. Van Buren Street, Chicago 7, Illinois
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Equipment News

CONTINUED FROM PAGE 16A

Balance-Beam Control for Variable Speed Drives

New control, called Serv-trol, automatically regulates pumping speed when used with magnetic drives, variable speed motors, water rheostats and servo mechanisms. It can be used to program multiple constant and variable speed drives to match any required pumping capacity.

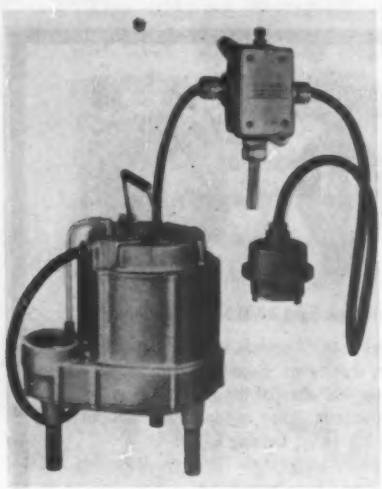
Serv-trol utilizes the balance-beam principle and operates without the need of instrument air. Any change in liquid level or system pressure upsets the balance, and in the correction of this unbalanced condition it repositions a pilot potentiometer. The potentiometer, through a servo mechanism and pump controller, adjusts the pumping capacity to match the new system requirements.—Healy-Ruff Co.

Circle No. 1215 on Reader Service Card

Submersible Pumps

Greater versatility in sump pump applications is now possible with Kenco Pump's new model 139-VTO heavy-duty, high-capacity, non-clog submersible pump equipped with variable turn-on control for controlled pumping up to 18-ft turn-on.

This combination of the variable turn-on control that eliminates frequent pump cycling and permits removal of measured amounts of fluid with Kenco's new Model 139 sump pump delivers the greatest pumping power of any sump pump with ½-hp. motor—8600 gallons per hour at a 5-ft head and 6900 gph at 10-ft head.—Kenco Pump Div., The American Crucible Products Co.



Circle No. 1216 on Reader Service Card

Low-Cost Drying Oven

A new low-cost, compact drying oven has been designed by this manufacturer. Of metal outer construction, the new multi-purpose oven can be used in a wide variety of industrial, research and educational drying, curing and testing operations. Operating range is from room temperature to 200°C.

The oven's compact design and outside measurements make it useful in laboratories for small unit operations. The inside chamber dimensions are 10 in. high, 12 in. wide and 10.1 deep. A perforated shelf separates the chamber from the heating element and a second shelf can be used in two positions.—Central Scientific Co.

Circle No. 1217 on Reader Service Card

New Trencher Attachment

A new "T" footing cutter has been developed by The Charles Machine Works, Inc., of Perry, Oklahoma, as an attachment to the DITCH WITCH trencher line. The "T" footer illustrated can be mounted on any DITCH WITCH trencher in the M3 and M4 series, either rubber tired or crawler mounted units.

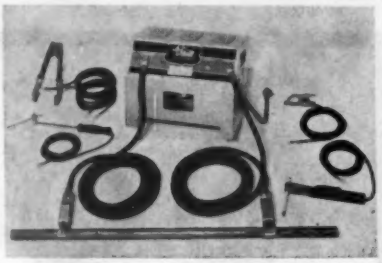
With this attachment, the user can dig a foundation footing with 8" stem and 16" "T" footing as pictured, which is suited to most light construction. For heavier jobs, a 12 in. stem, 25 in. "T" footing cutter which

mounts on the DITCH WITCH K2, 4-wheel drive trencher, is available. Use of the "T" footing cutter will greatly reduce building costs by eliminating forming and saving concrete.—Witch Marketing Co.

Circle No. 1218 on Reader Service Card

Pipe Thawer

Tremendous losses have been caused by inept methods of thawing frozen water pipes. A bonfire of newspapers under a sink. A salamander igniting its surroundings. A prime culprit is the man with the blow torch. A handful of lighted material run along a basement pipe line. All of these and anything else that omits a hundred percent safety factor, inevitably spell out fire, disaster and loss of life.



Today we employ electronics. See how simple it is. The illustration shows a Therm-O-Tron Pipe Thawer, Clamp it on the pipe. Plug it in like you do a radio. That is all. With perfect and absolute safety, without a single hazard, with not a single chance of damage, and usually in but a few minutes time, the freeze melts; even though it is underground and as far as eighty feet distant.—Trindl Products, Ltd.

Circle No. 1219 on Reader Service Card

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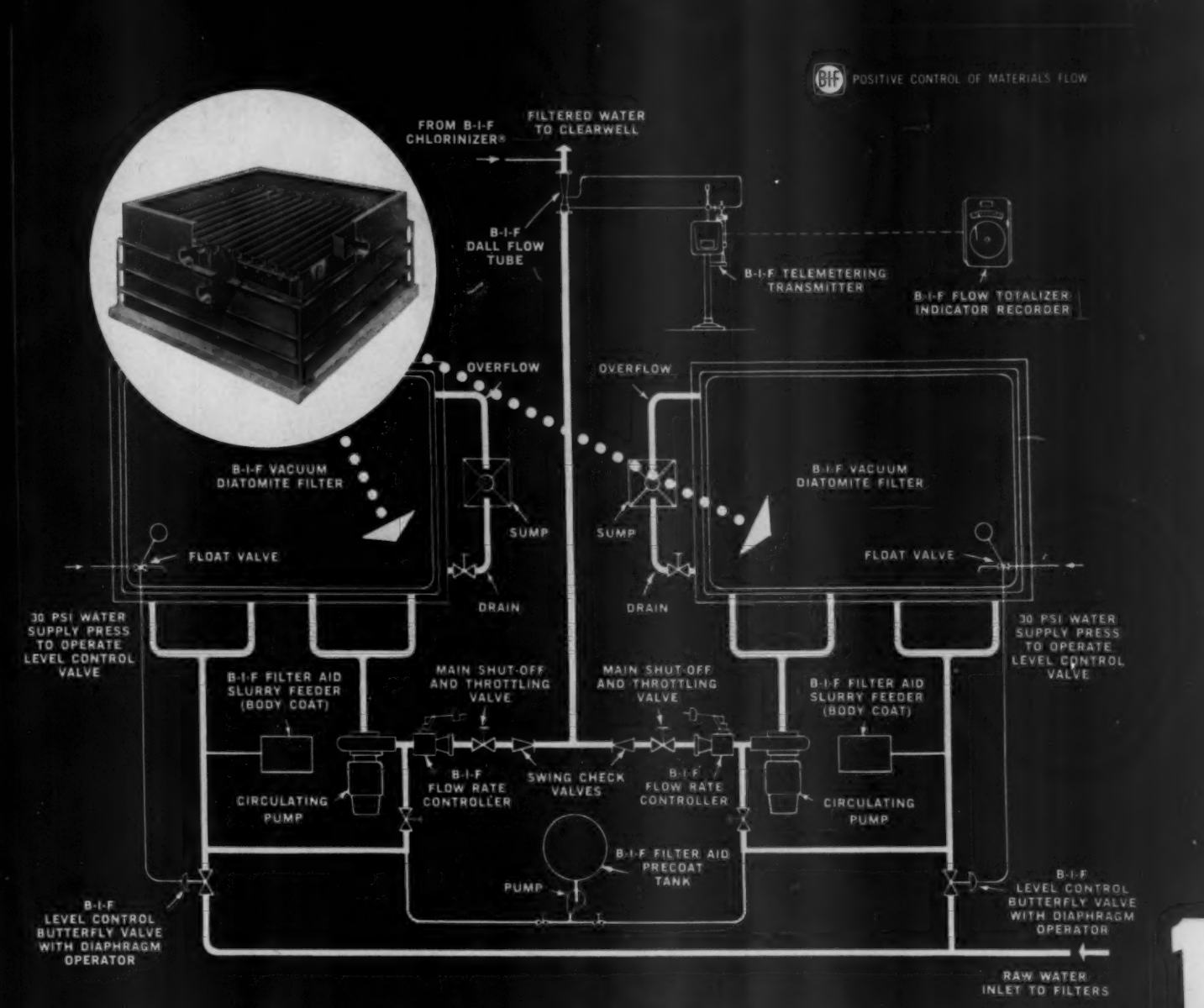

POSITIVE CONTROL OF MATERIALS FLOW
FROM B-I-F CHLORINIZER®
FILTERED WATER TO CLEARWELL
B-I-F DALL FLOW TUBE
B-I-F TELEMETERING TRANSMITTER
B-I-F FLOW TOTALIZER INDICATOR RECORDER
OVERFLOW
OVERFLOW
B-I-F VACUUM DIATOMITE FILTER
B-I-F VACUUM DIATOMITE FILTER
SUMP
SUMP
FLOAT VALVE
FLOAT VALVE
DRAIN
DRAIN
30 PSI WATER SUPPLY PRESS TO OPERATE LEVEL CONTROL VALVE
30 PSI WATER SUPPLY PRESS TO OPERATE LEVEL CONTROL VALVE
B-I-F FILTER AID SLURRY FEEDER (BODY COAT)
B-I-F FILTER AID SLURRY FEEDER (BODY COAT)
MAIN SHUT-OFF AND THROTTLING VALVE
MAIN SHUT-OFF AND THROTTLING VALVE
B-I-F FLOW RATE CONTROLLER
SWING CHECK VALVES
B-I-F FLOW RATE CONTROLLER
CIRCULATING PUMP
CIRCULATING PUMP
B-I-F FILTER AID PRECOAT TANK
PUMP
B-I-F LEVEL CONTROL BUTTERFLY VALVE WITH DIAPHRAGM OPERATOR
B-I-F LEVEL CONTROL BUTTERFLY VALVE WITH DIAPHRAGM OPERATOR
RAW WATER INLET TO FILTERS

New **B-I-F** *low cost filtration system meets peak load demands!*

You no longer need high cost expansion to meet peak load demands. At a fraction of the cost formerly required, B-I-F can provide a completely integrated filtration and treatment system. The low installation, operational and maintenance costs save thousands of taxpayers' dollars.

This B-I-F system is built around low cost, performance proven Vacuum Diatomite Filters. The filters' open tank design permits simple visual operation . . . and easier inspection and accessibility. Fiberglass construction eliminates annual painting and repair of protective linings. Chemical pre-treatment is simplified. Wash water requirements are minimized.

From its line of compatible components . . . filters, chemical feeders, instrumentation, butterfly valves, etc. . . . B-I-F will provide a coordinated system to meet your specific peak load requirement. A B-I-F system requires minimum start-up time . . . assures maximum reliability, flexibility for further expansion, and dependable, single responsibility.

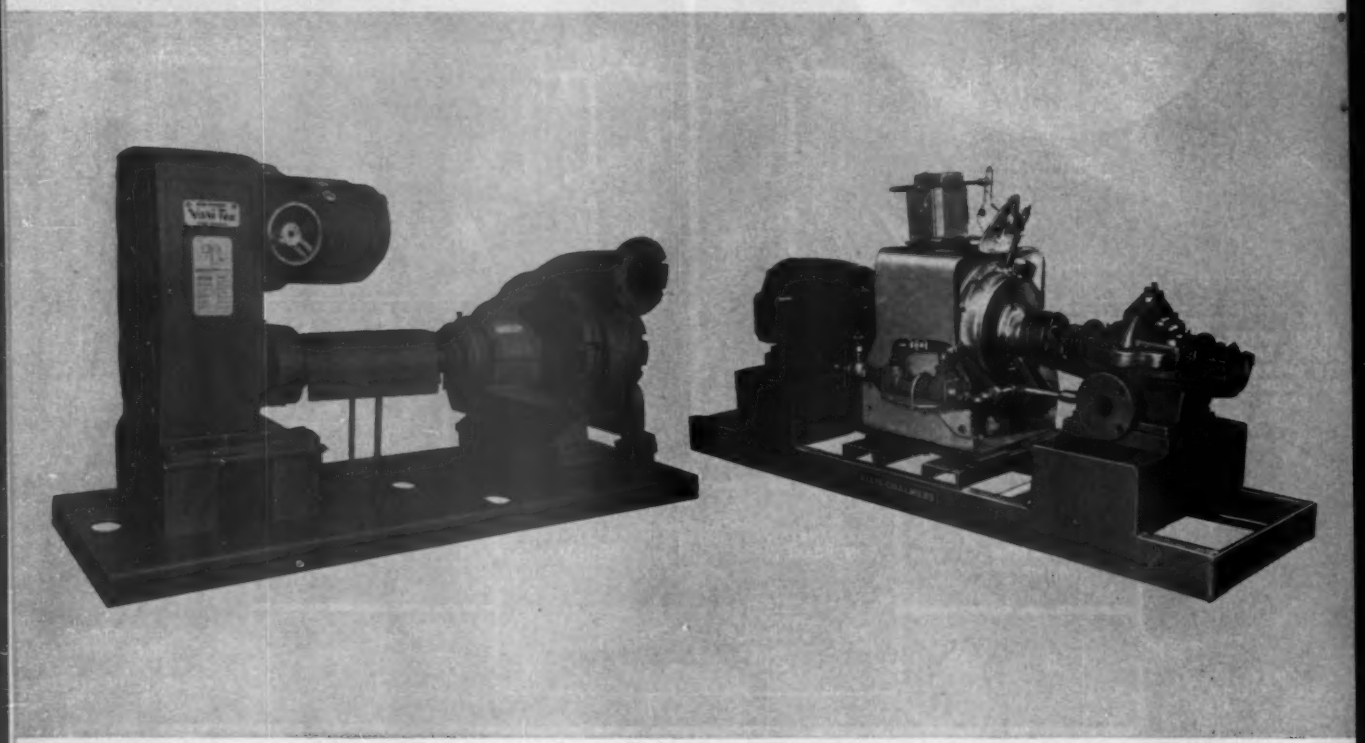
Write for the facts! B-I-F Industries, 376 Harris Ave., Providence 1, Rhode Island.

B-I-F Industries

A DIVISION OF THE NEW YORK AIR BRAKE COMPANY

METERS • FEEDERS • CONTROLS / CONTINUOUS PROCESS ENGINEERING

ideas and news:



Two new ways to meet variable pumping demands with varying speed: The unit at the left is an A-C 8x6 PWG pump, driven by a 20-hp VARI-TEX speed changer. It transports dye wastes to a sewage disposal plant . . . mixes them with raw sewage to a precise ratio. Because the VARI-TEX unit provides a near-infinite number of drive speeds, it eliminates the need for additional pumps of various capacities. The ACCUPRESSURE system at the right utilizes a fluid drive for variable speed. A single unit can be used to supplement constant-speed pumps — allowing a variable capacity auxiliary to be inserted at critical steps of any operation. The ACCUPRESSURE system can regulate a clear-well level, or operate directly from a capacity measurement signal to maintain line pressure as required by the system. The ACCUPRESSURE system permits accurate matching of inflow to outflow, so that the wet-well size of any station may be reduced.

Which of these productive ideas could be working for you?

Pumps that adjust to meet changing volume requirements. A system that converts waste sludge into high-quality lime. A control center that cuts costs. These examples demonstrate the extra value that is standard with A-C...the greater efficiency and added productivity which are yours when you buy A-C products, systems and services. Call your Allis-Chalmers representative for details on A-C "worth-more" features. Or write Allis-Chalmers, Industries Group, 904 South 70th Street, Milwaukee 1, Wisconsin.

A-1543

Vari-Tex, Accupressure and Track-Guide are Allis-Chalmers trademarks.

Valves "stand at attention," but will need little: Only A-C rubber-seated butterfly valves provide complete body protection. Their exclusive through-type rubber seat covers the entire inner body and extends over the flange faces. It provides an even flow pattern . . . eliminates oxidation and tuberculation. And the angle-seated vane assures positive, bubble-tight closure. The four 90-inch valves shown are to be used for pump check in a midwestern city.

New lime recovery plant turns sludge into savings: A midwestern city recently installed this A-C 150-tpd lime recovery system. Previously, purchased lime had to be discarded after it was used for water-softening. Now this 9½ x 265-ft rotary kiln — equipped with a unique arrangement of tube coolers — recovers more lime than the city consumes. The surplus produces extra revenue.

New control centers designed to cut costs: Allis-Chalmers redesigned low-voltage control centers feature TRACK-GUIDE drawout mechanism which permits individual control units to be drawn out, tilted up, or completely removed without tools. Exclusive plug-in terminal blocks save wiring time, prevent errors. Other features increase reliability and safety.

ALLIS-CHALMERS PRODUCTS: Look to Allis-Chalmers for compressors; controls; coolers; crushers; earth-moving equipment; engines; generators; industrial systems; kilns; lift trucks; motors; pumps; rectifiers; screens; electrical generation and distribution equipment; tractors; transformers; unit substations; valves; water conditioning equipment.

ALLIS-CHALMERS

Rugged, every inch of the way

Cast iron pipe was made for tough jobs such as sewage disposal. It resists attack by sewage and sewage gases that require expensive linings in other types of pipe; it keeps sewage flowing smoothly.

Cast iron pipe performs a tough job. It stands up to external and internal loads, shocks and pressures. Bottle-tight joints *eliminate* seepage and infiltration at the most vulnerable points of your system.

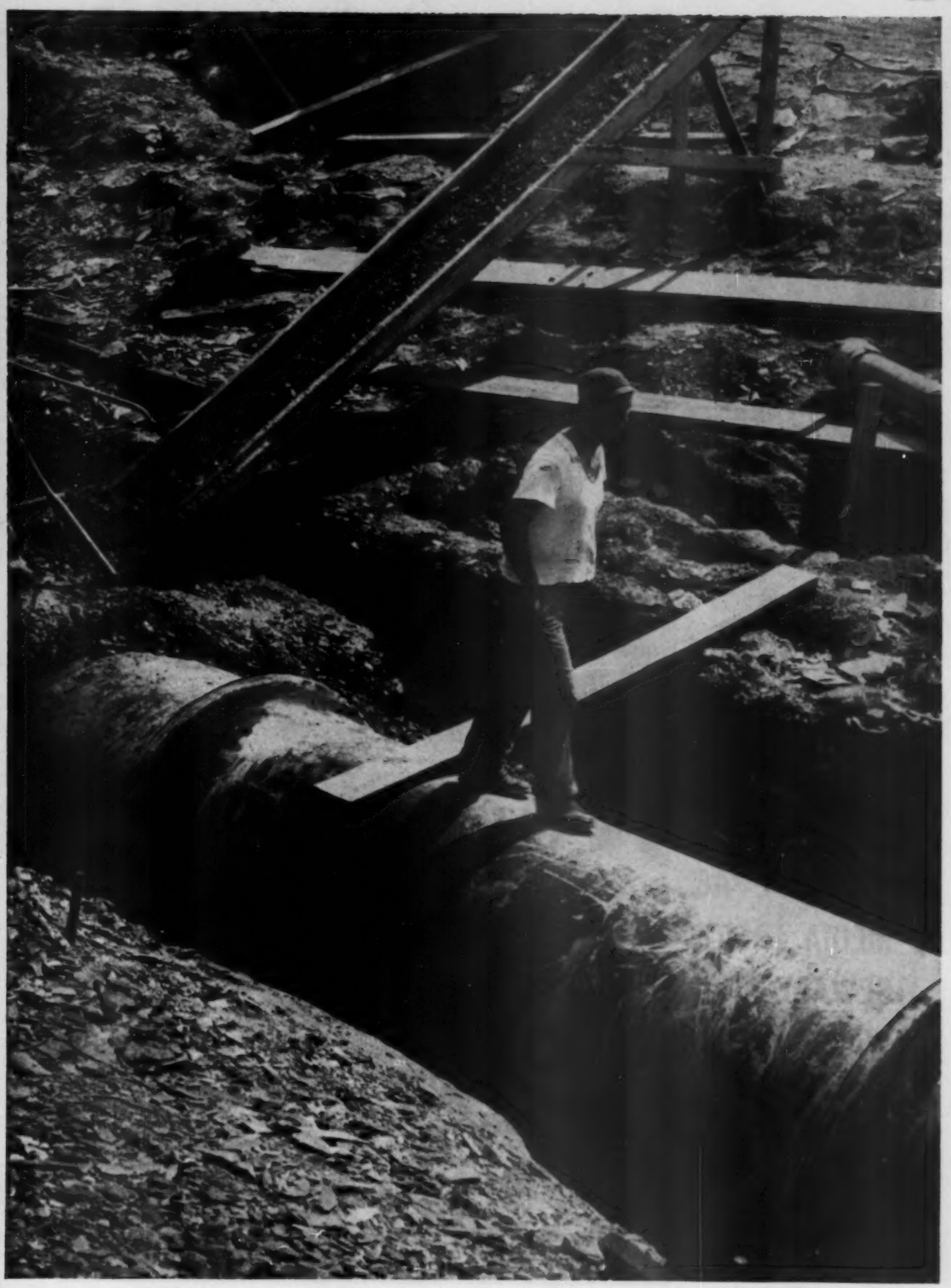
Cast iron pipe is rugged every inch of the way . . . and will remain so for over a century.

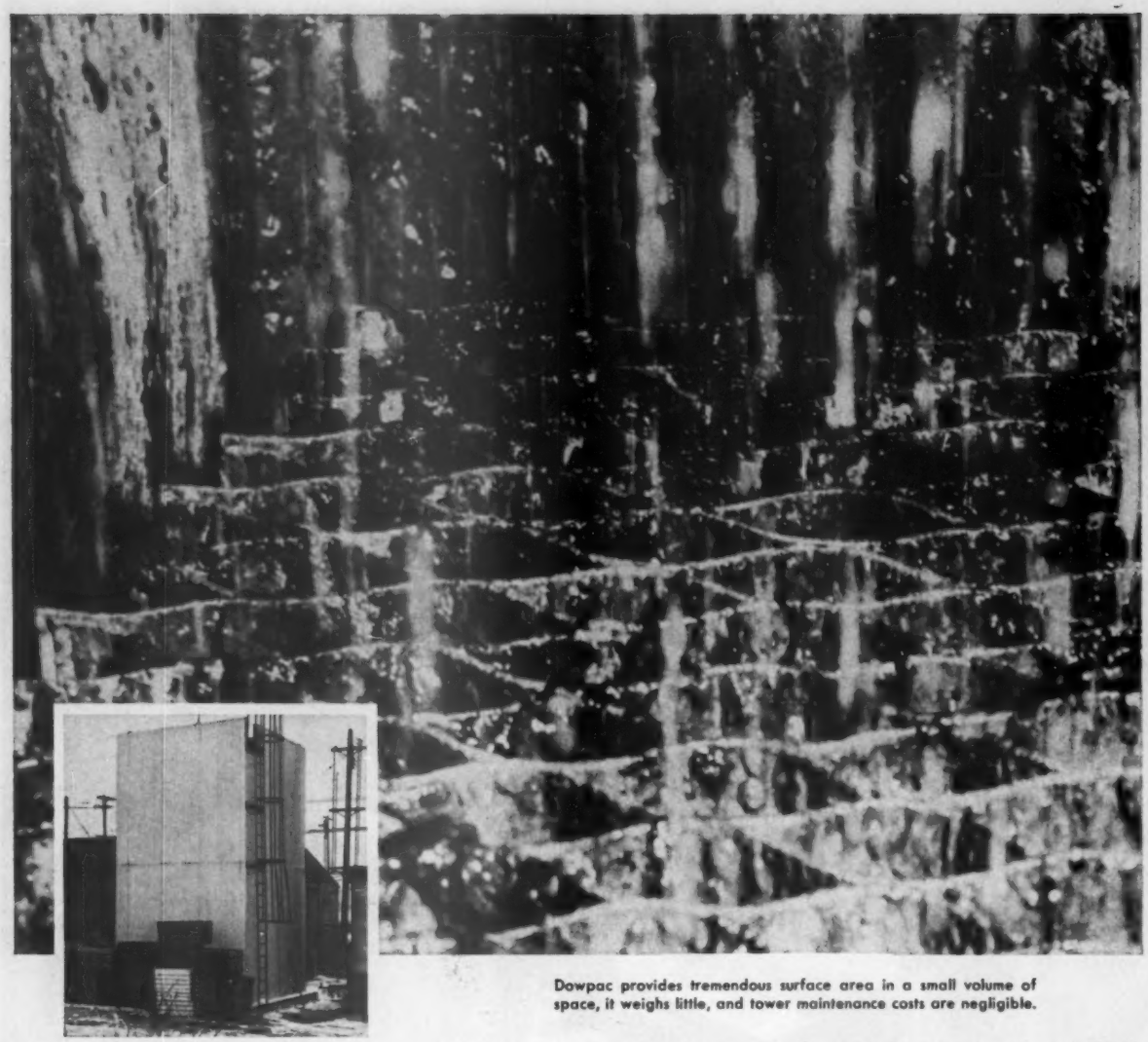
CAST IRON PIPE

THE MARK OF PIPE THAT LASTS OVER 100 YEARS

CAST IRON PIPE RESEARCH ASSOCIATION

Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois





Dowpac provides tremendous surface area in a small volume of space, it weighs little, and tower maintenance costs are negligible.

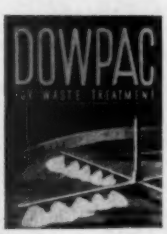
NEW DOWPAC MEDIA TREAT SEWAGE AND WASTE FAST IN LITTLE SPACE

. . . D.I.S. offers low-cost pilot plant to prove system for your waste conditions!

Contoured plastic sheets of Dowpac® packing media interlock (above) to form a continuous, lightweight grid for low-cost treatment of water-borne wastes. Because of light weight and high operating efficiency, a waste treatment system using Dowpac requires much less land area for construction than other waste systems, while operating at higher waste concentrations.

Cost advantages—Economical first cost . . . low maintenance and operating costs . . . conserves expensive land. **Operating advantages**—large area for bacterial growth . . . efficient aeration . . . freedom from plugging. **Total advantages**—a D.I.S. waste treatment system using Dowpac costs you less to install and operate and treats more waste faster, at higher concentrations, than other kinds of systems.

Pilot plants employing Dowpac can be rented or purchased, and D.I.S. engineers will help customers develop the most effective use of Dowpac for their particular waste conditions. Dow Industrial Service works with industries of every kind, anywhere in the U. S. Further, D.I.S. offers consulting laboratory service for water and waste treatment, backed by technical resources of THE DOW CHEMICAL COMPANY. For further information, write or call DOW INDUSTRIAL SERVICE, 20575 Center Ridge Road, Cleveland 16, O., Dept. WSW12.



FREE BOOKLET on low-cost, high efficiency waste treatment using Dowpac. Send for a copy today.

DOW

Dowpac is a trademark for packing media—not pilot plants

DOW INDUSTRIAL SERVICE • Division of The Dow Chemical Company

IOWA Valves and Hydrants

by the carload to meet San Jose Water Works' growing requirements

Glimpse of new subdivision of San Jose, California. City has grown from 95,280 to 202,571 in past ten years.

Unloading scene as IOWA hydrants are delivered by the carload to San Jose Water Works.

Two IOWA gate valves and a new hydrant being installed. Hundreds of these Iowa products are important components of San Jose's modern system.

Carloads of IOWA gate valves and hydrants were purchased by the San Jose Water Works (an investor-owned, private company established in 1866) for installation in their rapidly expanding system which serves seven cities and unincorporated areas in Santa Clara County, California.

Over 17,000 new water service connections were made in the last two years along 1200 miles of water mains to help care for a metropolitan population (Approx. 306,000) which has doubled since 1950.

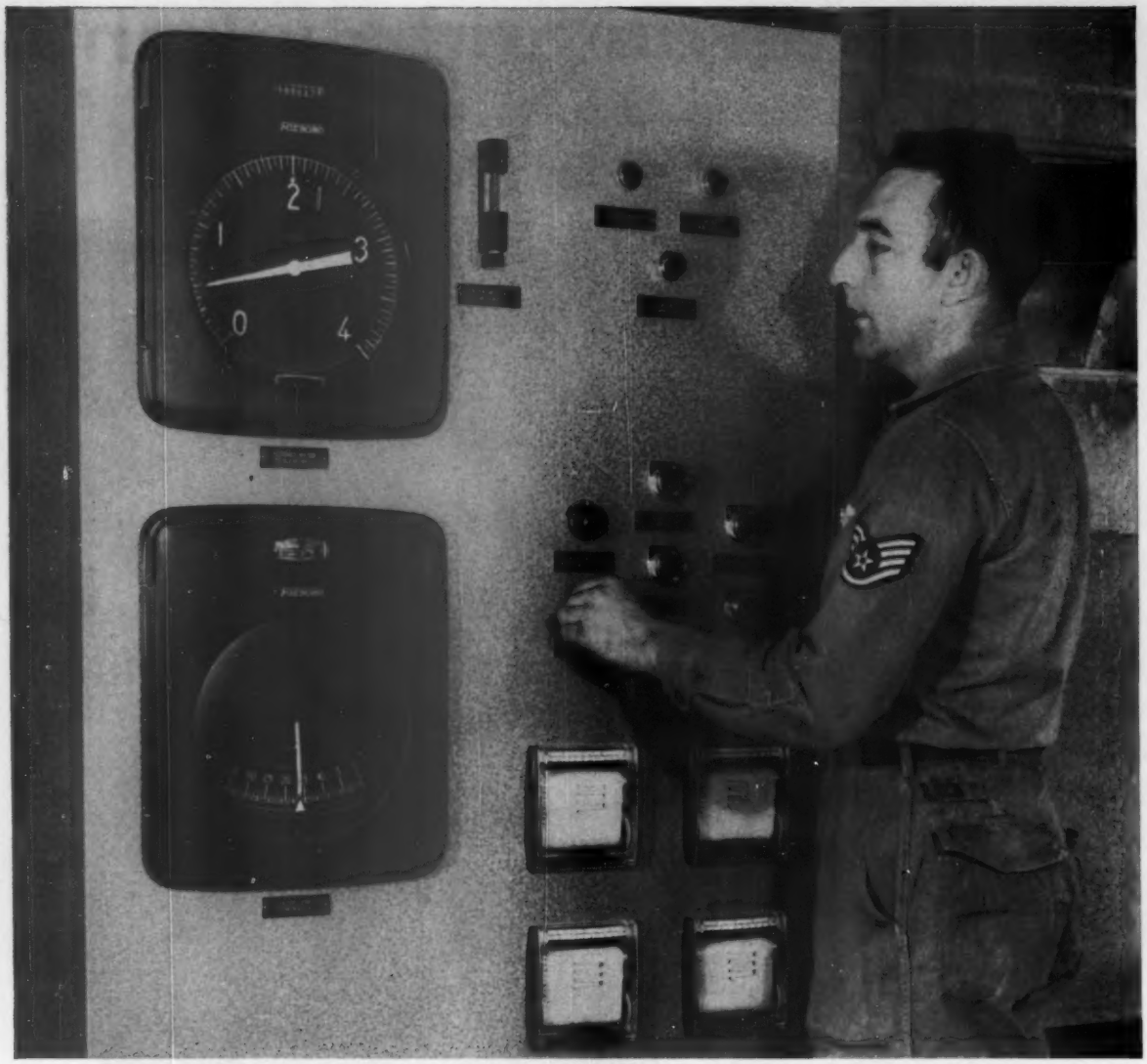
IOWA products were selected to be a part of the San Jose Water Works' growth because of their proved dependability with minimum maintenance and assurance of long-life performance.

Every year more and more IOWA valves and hydrants are installed to serve the needs of growing communities like San Jose. Experience shows that IOWA products have that extra quality of materials, that extra-precise fitting and assembly that makes for longer life and easier maintenance.

Let us send you details on the complete IOWA line

IOWA VALVE COMPANY
Oskaloosa, Iowa
Subsidiary of James B. Clow & Sons, Inc.

a CLOW Subsidiary



Foxboro Control Cabinet at Loring Air Force Base Water Treatment Plant. Cabinet contains: 1) *top left* — indicator for filtered water to clearwell 2) *lower left* — indicating controller for filter level 3) *lower right* — recorders for flow rates to filters.

It's Foxboro automatic control for new Loring Air Force Base water treatment plant

Five Air Force operators, the Little Madawaska River, and Foxboro Automatic Control . . . that's the water-supply team at the 10,000-man Loring Air Force Base at Limestone, Maine.

Completed in 1959, the new facility features the most advanced automatic control. Reservoir, clearwell, filters — all have flows and levels maintained automatically. There are no valves to crank, no visual checking to do. In fact, filter backwashing is the only manual push-button operation there is.

The five operators are all enlisted Air Force personnel. Since none had previous experience in any phase of water treatment, they were all thoroughly trained by Foxboro before the plant's start-up.

If you want to save time — save money in the operation of your plant, investigate Foxboro automatic control. Bulletin 1-15A has full details — write for it. The Foxboro Company, 8912 Neponset Ave., Foxboro, Mass.

**Reg. U.S. Pat. Off.*

FOXBORO

REG. U. S. PAT. OFF.

Water Treatment Plant at Loring Air Force Base has a capacity of 4 million gallons per day. Foxboro Teletax* Telemetering is used to link it with base facilities, some 5 miles away.

ON GUARD IN INDEPENDENCE SQUARE

About 75 feet away from Independence Hall, in the park to the south, stand R. D. Wood Hydrants like sentinels on duty. While their proximity to the Nation's most revered historic monument does not necessarily imply endorsement, we nevertheless like to think of them there, on guard night and day against the fire that could destroy what Gen. Howe saw fit to spare, and Clinton too, in the British occupation. But R. D. Wood Hydrants need no endorsement. For over a century they have shown themselves to be in constant readiness for any emergency. Of simple, ingenious design and rugged construction, R. D. Wood Hydrants are protected against ice and sediment—function smoothly when the engines arrive. There could be no better protection for any community than R. D. Wood Hydrants—and there could be no better protection for the birthplace of the U.S.A.

Conform to A.W.W.A. specifications

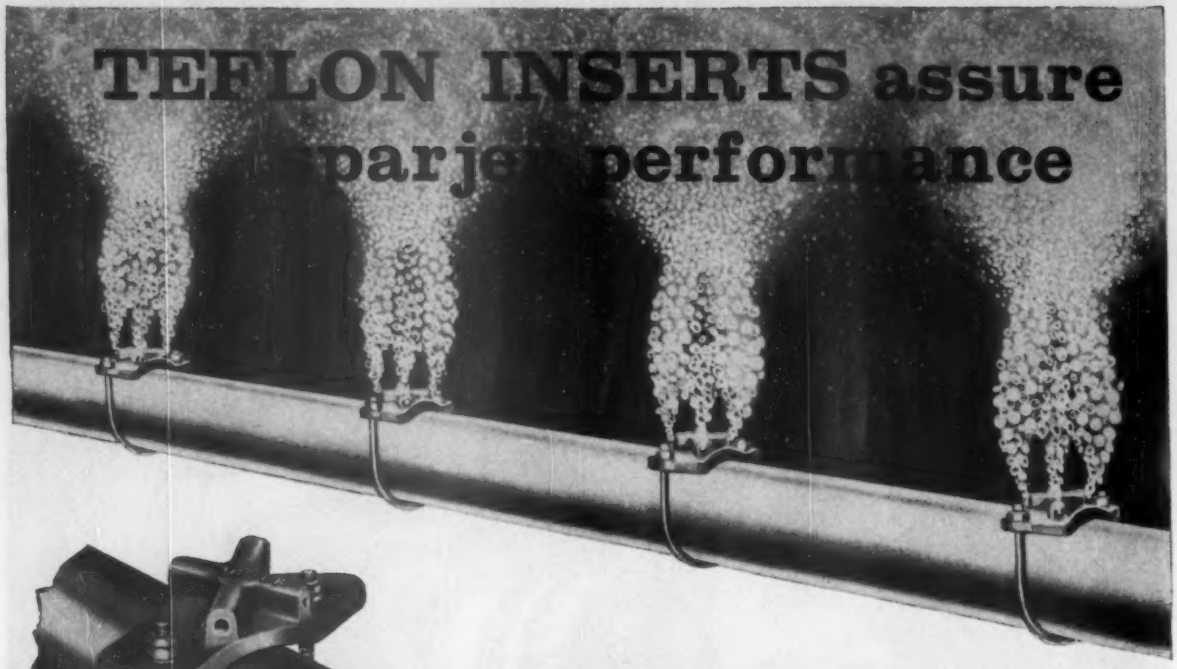
R. D. WOOD COMPANY

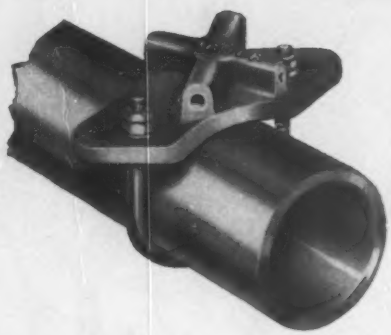
Established in 1803

FLORENCE
NEW JERSEY

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds)

TEFLON INSERTS assure sparjer performance

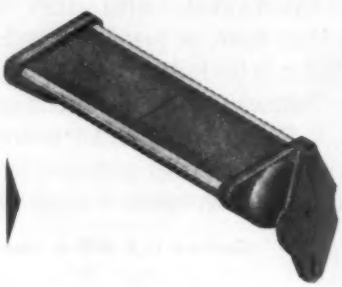




Repeating clusters of accurate Teflon orifices cause—
—sudden change in energy immediately above SPARJERS to produce small bubbles.
—exceptional air lift with greater tank "roll" and surface turbulence.

Now—with Teflon inserts — SPARJERS offer more assurance that even infrequent plugging will not occur. Oxygenation efficiency remains constant, operation is simplified, maintenance is avoided and power costs are reduced. Where ordinary air diffusers are plagued with progressive plugging; actual plant experience, in hundreds of installations, has proven that SPARJERS most nearly approach clog-proof operation. Particles cannot cling to the exceedingly slick Teflon surface. Also, the electroplating phenomena, encountered when certain colloidal clays are present in the sewage, is avoided. SPARJERS, properly applied, give oxygen transfer efficiencies equal to diffuser tubes. No elaborate air filters required; utilizes inexpensive oil-wetted wire baffle-type unit. Operates trouble-free in all solids-in-liquids combinations—even in digesters charged with thickened sludges. More and more installations are replacing their tube diffusers with SPARJERS; and none have ever had to increase their air supply. Send for installation list.

Walker Process also offers PLATE-TUBE diffusers for unusually low air release applications. JACK-KNIFE pivotal headers provide a convenient and economical method of installing SPARJERS or PLATE-TUBES without extensive on-the-job pipe work.



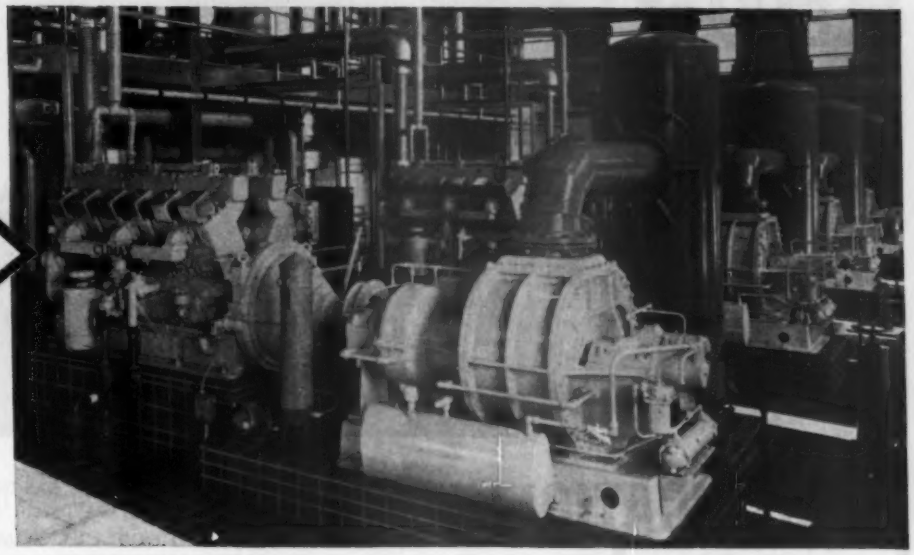
WALKER PROCESS Walker Process Equipment Inc.

FACTORY • ENGINEERING OFFICES • LABORATORIES • AURORA, ILLINOIS

in this Mansfield, Ohio $4 Million sewage plant...

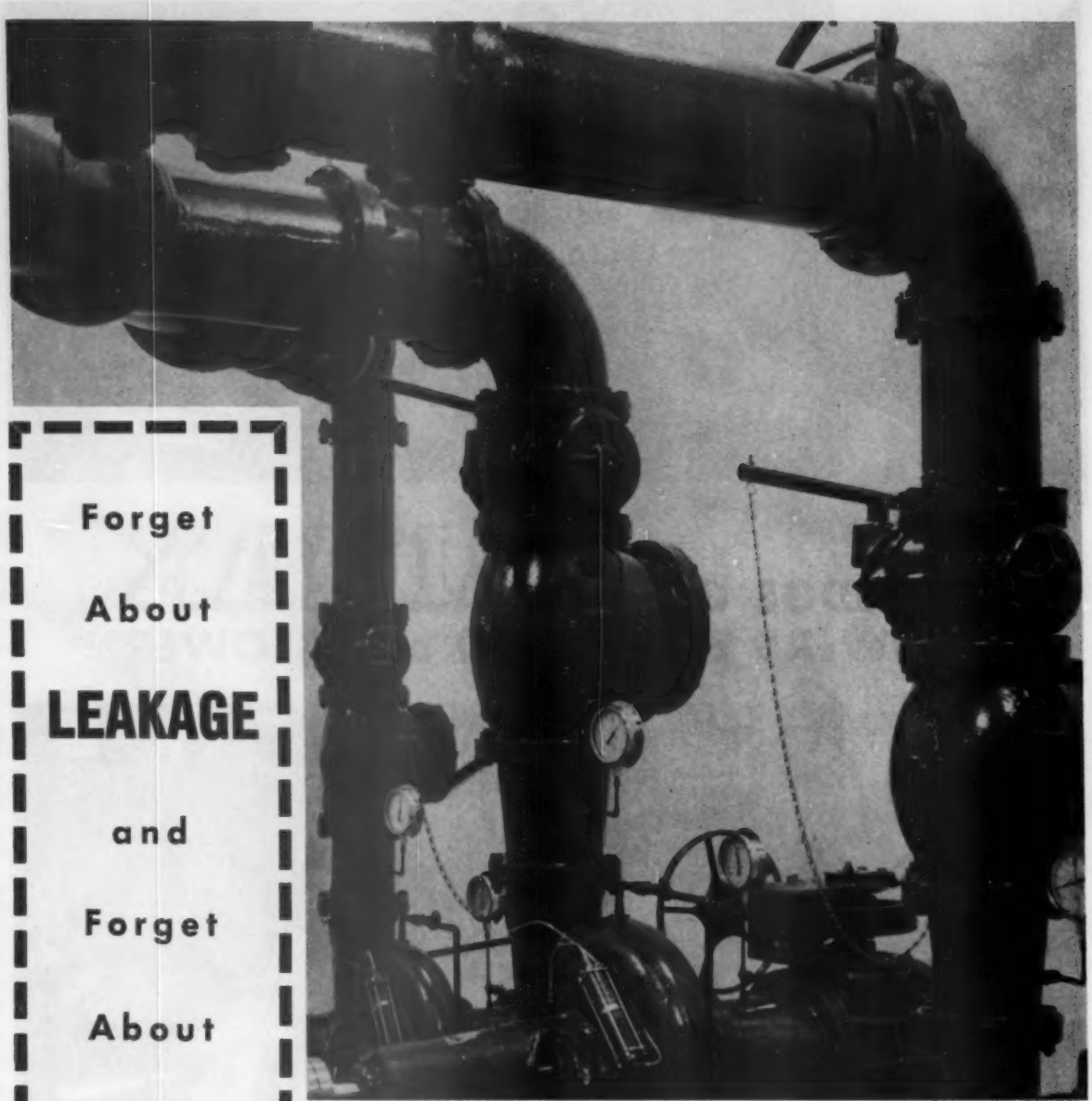
A SLUDGE GAS CLIMAX POWERS EACH 5250 cfm BLOWER

Four CLIMAX V-125 Engines



Mansfield, Ohio, puts money back in the taxpayer's pocket with Climax Power *economy*. In its recently completed sewage treatment plant, digester gas fuels the four Climax Engines driving the blowers. Used for aeration, grease and grit removal, are four 18 x 21 RCDH Roots-Connersville blowers. Capacity of each blower is 5250 cfm. And each has a V-125, 12-cyl., 7½ x 7-in., 3711 cu. in. displ. Climax Engine operating on sludge gas at 650 rpm and delivering 225 hp. • Engineering Controls, Inc., St. Louis, Mo., supplied the vapor phase cooling system. Floyd D. Browne & Associates, Marion, Ohio, are the Consulting Engineers. • *Send for bulletins* on Climax sewage plant engines: 12, 8, 6 cyl.; sludge gas, or natural gas, butane, gasoline, or any combination fuel; 100 hp to over 600 hp. CL-120

CLIMAX ENGINE MANUFACTURING CO. • DIVISION OF WAUKESHA MOTOR COMPANY
FACTORY—CLINTON, IOWA



Forget
About
LEAKAGE
and
Forget
About
LUBRICATION!

DeZurik Eccentric-Action Valves are available in sizes to 30", manual or automatic operation. Consult your DeZurik Representative or write for catalog and recommendations.

NOT JUST DRIP-TIGHT, BUT GAS-TIGHT . . . that's the leak-free shut-off you're sure of with DeZurik ECCENTRIC-ACTION Valves.

And you get it WITHOUT LUBRICATION, without periodic attention, without fail, no matter what's in the line or the flow!

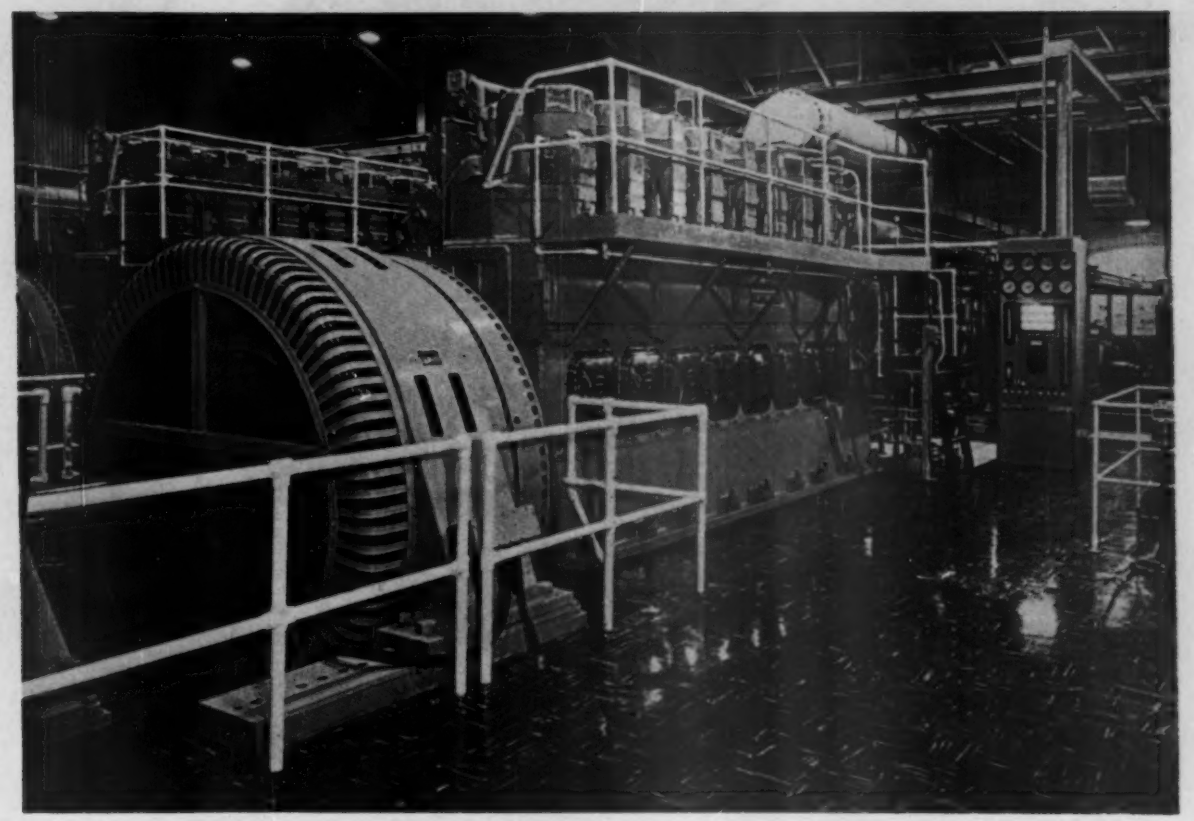
DeZurik's ECCENTRIC ACTION has proved itself the ideal valving answer in virtually every phase of sewage-and-waste handling and treatment. The non-rubbing, free-moving plug operates with complete ease in a fast quarter-turn, with fine throttling thru its range, with no binding, no clogging, and no lubrication ever! Hundreds of sewage plants keep adding every day to the record of DeZurik Valves as the NO-TROUBLE, COST-CUTTING, TIME-SAVING VALVES on sewage services.

DeZURIK Corporation
Sartell, Minnesota
DeZURIK OF CANADA, LTD. Galt, Ontario

MORE POWER

to the CITY OF RAYNE, LOUISIANA

...from ENTERPRISE



Enterprise heavy-duty Engines are designed for the most exacting requirements—in electric power generation, sewage power plant and pumping systems—size from 73 to 7703 hp —using diesel, dual-fuel, tri-fuel or spark-ignited gas.

These two new 1750 KW Enterprise Engine Generator Sets assure the citizens of Rayne, Louisiana, of an adequate and *dependable* source of electric power.

ENTERPRISE Engines

Power Division of General Metals Corporation

A SUBSIDIARY OF TRANSAMERICA CORPORATION

550 85TH AVE., OAKLAND 21, CALIF. • 37-02 48TH AVE., LONG ISLAND CITY 1, N. Y. — National and worldwide sales and service

...15 seconds with Fairbanks-Morse Diesels

The F-M 38D8⅛ Opposed-Piston Diesel Generating Unit—with only 15 seconds *from cold start* to full power—gives fast, sure power for peaking or for standby use, together with impressive operating economies.

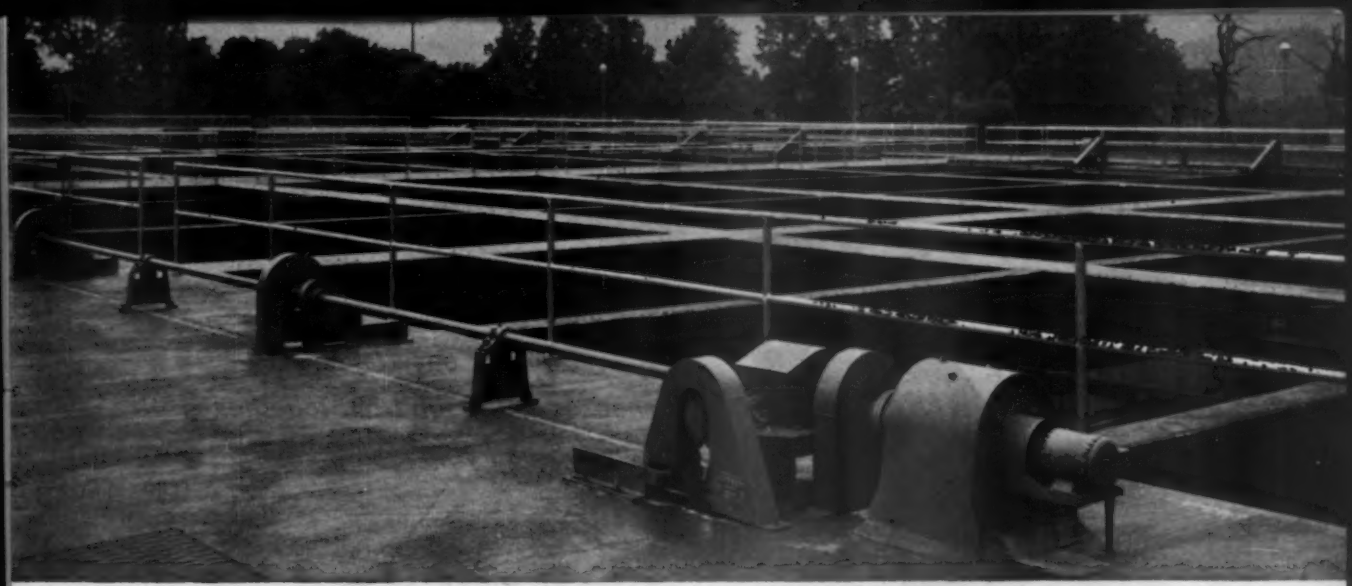
This unit requires no spinning reserve . . . uses no power until it starts, then produces up to 2500 kw per unit. Can be linked in multiple units.

Dependable? Service records of F-M Diesels prove dependability beyond a doubt (F-M pioneered the manufacture of diesels in America . . . has kept in the forefront ever since.)

Economical? The 38D8⅛ has 40% fewer moving parts than comparable engines of equal horsepower. This means reduced maintenance costs . . . fuel and lube oil savings.

Opposed-piston design minimizes vibration, produces fine balance . . . smooth power and instant response that result in 15 second full-power operation. Available with 4, 5, 6, 8, 10 or 12 cylinders, ranging from 450 to 2500 kw per unit, with automatic or manual controls. **For full details or custom specifications, write today to: S. K. Howard; Director of Marketing; Fairbanks, Morse & Co.; Beloit Division; Beloit, Wisconsin.**

FAIRBANKS MORSE
A MAJOR INDUSTRIAL COMPONENT OF
FAIRBANKS WHITNEY



CHATTANOOGA CHOOSES JEFFREY SEWAGE TREATMENT EQUIPMENT AGAIN

Shown here is the original Jeffrey sewage treatment equipment installed at Chattanooga. Recently, the city expanded its treatment capacity, ordered almost identical Jeffrey equipment. Havens & Emerson of Cleveland, Ohio and New York City were the engineers. Shown above are the primary settling tanks featuring the Jeffrey tank drive units designed especially for sewage treatment plant service. Shown below are the power-driven scum skimmers with long-wearing Jeffrey sprocket, chain and flight assemblies. Jeffrey's Sanitary Engineering Division offers complete technical assistance in designing and equipping water, sewage and industrial waste treatment installations. For further information, write today for Catalog 952, The Jeffrey Manufacturing Company, 996 North Fourth Street, Columbus 16, Ohio.

If it's conveyed, processed or mined, it's a job for Jeffrey.

JEFFREY

U.S. cast iron **PIPE** FOR WATER, SEWERAGE AND

a honey to handle

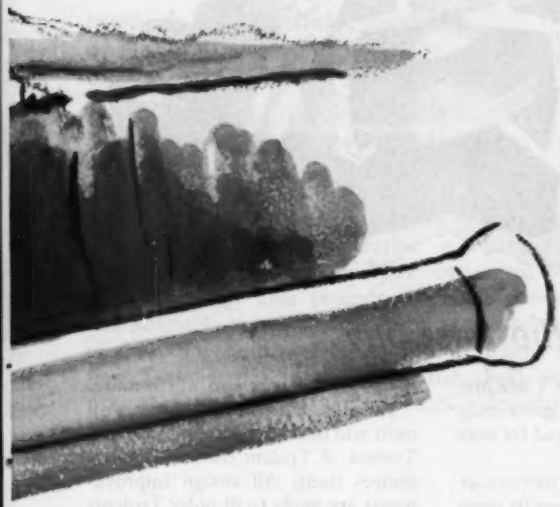
Tyton Joint® pipe, naturally . . .

This rugged dependable pipe goes together so easily even green crews become experts quickly. Consider:

Only one accessory needed—a rubber gasket. No nuts, bolts, bell holes, caulking equipment. And Tyton can be laid in rain or wet trench when necessary.

High installation costs crowding your budget? Get the time-and-money-saving facts on Tyton Joint* pipe today. Call or write:

*U. S. Patent No. 2,953,398 *



U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

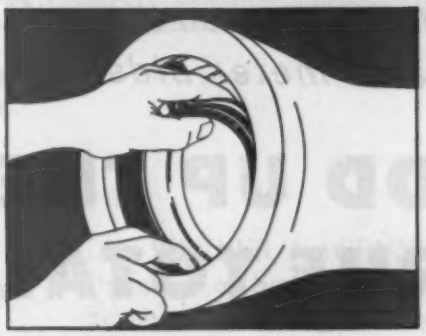
A Wholly Integrated Producer from Mines and Blast Furnaces to Finished Pipe.

Makers of USIFLEX® Boltless Flexible Joint Pipe.

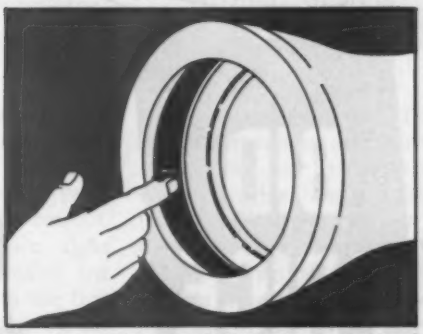
INDUSTRIAL SERVICE CAST IRON®

TYTON®

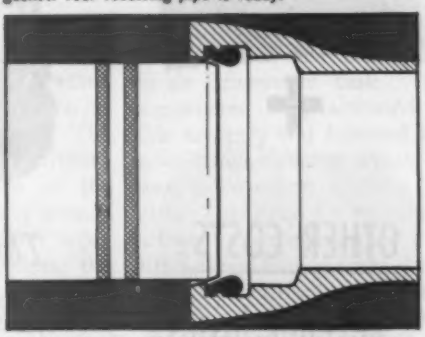
ONLY FOUR SIMPLE ACTIONS



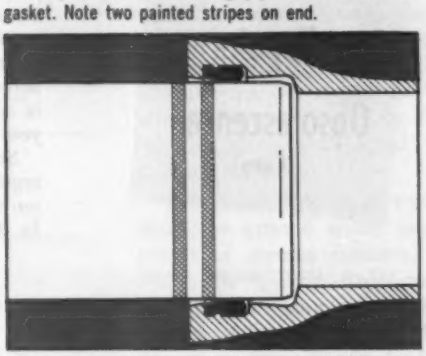
Insert gasket with groove over bead in gasket seat . . . a simple hand operation.



Wipe film of Tyton Joint® lubricant over inside of gasket. Your receiving pipe is ready.



Insert plain end of entering pipe until it touches gasket. Note two painted stripes on end.



Push entering pipe until the first painted stripe disappears and the second stripe is approximately flush with bell face. The joint is sealed . . . bottle-tight, permanently! The job's done . . . . fast, efficiently, economically. Could anything be simpler?

When you open the water meter bids...

ADD UP THE TRUE TOTAL

New Trident Model 60 Sealed Meter

THEN make the best buy...

A water meter should be a lifetime purchase. Its price tag gives only *part* of its cost. Look instead for *true annual costs:*

First, think of revenue loss. A meter returns 12 to 20 times its price before its first check-up. A slight slip in accuracy loses more money than you "save" in a low bid.

Secondly, meters must be tested regularly. One that checks OK *without* repairs obviously is worth more. In the long run, the meter that is *easiest* to repair is also worth more.

Finally, with most meters you must add obsolescence. But not with Trident. A Trident constantly modernizes itself. All design improvements are made to fit older Tridents too; you get them *automatically* as you insert replacement parts.

Trident meters are designed not for low bid but for low true annual cost. That's why Trident is always your "best buy."

Ask your Neptune representative.

neptune METER COMPANY

LIQUID METER DIVISION • 47-25 34th Street, Long Island City 1, N. Y.

OFFICES IN PRINCIPAL CITIES • In Canada: Neptune Meters Ltd., 1430 Lakeshore Rd., Toronto 14, Ont.

Vol. 108, No. 12 • December 1961
WATER & SEWAGE WORKS
A Scranton Gillette Publication

Methods used in Maine and New Hampshire to study . . .

Natural Radioactivity In Ground Water - Part 2

by DR. WERNER N. GRUNE
Professor of Sanitary Engineering
School of Civil Engineering
Georgia Institute of Technology
Atlanta, Georgia

■ THE PURPOSE of this study was to develop a simple, reliable and reproducible method for the analysis of certain naturally occurring radioisotopes in water. The procedures were to be applied to the analysis of ground water supplies during a field sampling program. Requirements differed from those of many analytical methods in that equipment had to be compact and portable. To achieve significant results during a comprehensive field survey, it was desirable that analytical procedures be as rapid as possible without loss of accuracy.

Methods for the Determination of Radon^{222}, Radium^{226} and Lead^{210}

Preliminary to the field survey, four analytical approaches were investigated in the solution of the problem. The first involved the precipitation of radon^{222} daughters as sulfides, with subsequent separation on a millipore filter for analysis by alpha counting. This procedure was not satisfactory because of clogging of the millipore paper during filtration. The clogging resulted from the presence of an unknown, pinkish-brown colloidal substance which could not be removed by filtration before precipitation. As part of this study, a sample was filtered through twice without the addition of any reagent. Comparison with the known alpha activity of the sample revealed low radon daughter recovery on the first filter and was substantiated by the relatively large alpha activity retained on the second filter.

The second analytical procedure tried was to determine radon^{222} and lead^{210}. The solvent extraction method was employed for the separation of lead and bismuth from water. The extracting agent was diphenylthiocarbazone, commonly used in the colorimetric analysis of heavy metals, dissolved in chloroform. After separation of the radon daughters, the lead and bismuth dithizonates were deposited on a planchet by evaporation of the chloroform. The radon concentration was determined by an alpha count and by use of the theoretical daughter decay relationships, lead^{210} was determined by allowing the short-lived daughters to decay before recounting for beta activity. Results were inconclusive because of nonuniform deposition of solids on the planchets.

A third analytical procedure involved the de-emanation of radon^{222} from solution, collection of the gases in an Erlenmeyer flask coated with a powdered, silver-activated zinc sulfide screen*, and followed by alpha scintillation counting. Water samples were collected in specially designed glass bubblers. De-emanation was achieved by means of an evacuated Erlenmeyer flask connected to a bubbler. A sketch of the bubbler and the scintillation flask is shown in Figure 3. Vacuum produced an upward flow of air through the bubbler and resulted in radon removal from the water and collection in the flask. The analysis was completed by alpha scintillation counting of the flask, using the specially designed detection unit and a scaler.

The fourth approach was to analyze the ground water samples by means of gamma emitters, such as Pb^{210}, Pb^{214}, Bi^{214}, Rn^{219} and Ra^{229}. A well water sample from the C. D. Brown residence at Raymond, Maine, known to contain a radon^{222} (plus daughters) activity of approximately

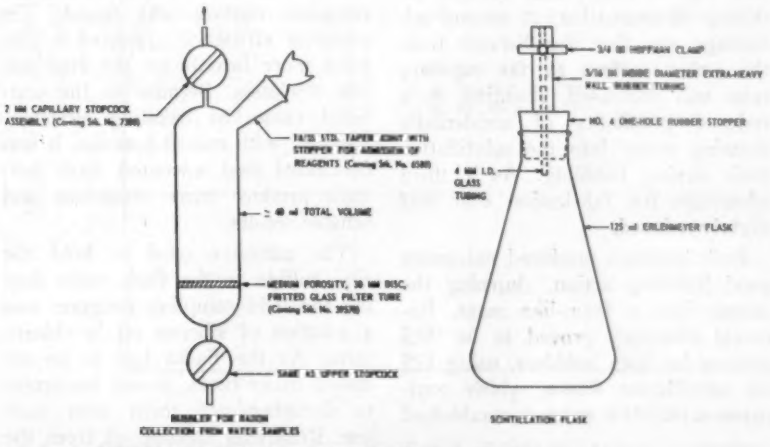

2 MM CAPILLARY STOPCOCK ASSEMBLY
TAPER JOINT WITH STOPPER FOR ADMISSION OF REAGENTS
≥ 40 ml TOTAL VOLUME
MEDIUM POROSITY, 30 MM DISC, FRITTED GLASS FILTER TUBE
SAME AS UPPER STOPCOCK
BUBBLER FOR RADON COLLECTION FROM WATER SAMPLES
3/4 IN HOFFMAN CLAMP
NO. 4 ONE-HOLE RUBBER STOPPER
4 MM I.D. GLASS TUBING
125 ml ERLENMEYER FLASK
SCINTILLATION FLASK

Fig. 3. SKETCH OF Bubbler and Scintillation Flask.

* The thickness of the zinc sulfide layer was found, by weighing 19 samples, to be 5.71 mg/cm^2 and to have a 95 percent confidence interval of ±0.85 mg/cm^2.

40,000 μμc/l, was chosen for the gamma-ray spectrum analysis. A one liter sample was concentrated to about 2 ml, or by a factor of about 500. For analysis, a B. J. Electronics, Model DZ-46, gamma ray spectrometer was employed, but although all available window widths, time constants and counting times were employed, no significant spectrum could be obtained due to the background and low counting rate.

Analysis after Modification

Radium^{226} was also analyzed using a simple modification of the de-emanation procedure. After de-emanation for radon analysis, the water sample was purged of any remaining radon. The bubbler was then sealed and a second radon analysis was performed on the sample 8 to 12 days later, allowing the build-up of radon from the radium in the sample. The radium content was calculated using the known state of partial equilibrium between the two radioelements.

Results

The results of the investigation of the sulfide precipitation and de-emanation procedures are listed below:

1. The precipitation, as sulfides, of the lead, bismuth, and polonium, daughters of radon^{222}, with subsequent collection on a millipore filter, produced poor results on certain well waters from Raymond because of clogging of the filter paper produced by an unknown precipitate.

2. The efficiency of radon removal from bubblers, by de-emanation averaged 99.3 percent when Corning Glass Works' components were used in bubbler construction. The removal efficiency of a second group of bubblers assembled from components produced by Consolidated Glass Works averaged 89.6 percent. Removal efficiencies were determined with standard radium solutions in the Corning bubblers, while the other bubblers were used exclusively for routine determinations of water samples.

3. The alpha counting efficiency of the scintillation detector varied with time due to the photomultiplier tube decay, necessitating frequent measurements and the use of corrections obtained from a graph of counting efficiency versus time.

4. The de-emanation method of radon analysis was reproducible on samples to within ± 9.19 percent, at 95 percent confidence, when the time interval between sampling was short.

All of the above analytical methods are described in more detail in the complete report[2]. The de-emanation procedure appeared to hold the most promise as an analytical tool. It is discussed below along with some recent modifications and improvements.

Evaluation of De-emanation Apparatus

A detailed description of the bubblers used in Maine and New Hampshire has been described in more detail[2]. When fabricated from Corning Glass Works' components, these bubblers produced very good results and allowed almost complete radon de-emanation from a 30 ml sample of water. Although the 30 ml sample size was adequate for most analyses, it was found that a larger volume would be desirable for low activity samples and radium analyses.

To evaluate the effect of increasing the sample size, two bubblers*, holding 45 and 60 mls, respectively, were fabricated. In addition to the increase in size, the sample spout was relocated from the side to the top of the bubbler. This change resulted in several improvements. First, the dead air space within the sample spout branch was eliminated, producing an air space above the liquid that may be more easily flushed out during de-emanation. A second advantage was that the distance from the water surface to the capillary tube was increased, resulting in a reduced possibility of accidentally drawing water into the scintillation flask during bubbling. As a third advantage the fabrication cost was slightly reduced.

Both bubblers produced extremely good bubbling action, churning the sample into a foam-like mass. Removal efficiency proved to be 99.5 percent for both bubblers, using 125 ml scintillation flasks, which compares with 99.3 percent established for the better group of original 30 ml size bubblers.

To arrive at an optimum scintillation flask for alpha scintillation counting of radon gas, several variables were considered: 1. optimum flask size concomitant with the different sizes of bubblers, 2. size of the light pipe on the flask bottom, 3. type of adhesive material to make the zinc sulfide coating adhere to the flasks, and 4. type of zinc sulfide to use.

The 30 ml bubblers made with Corning Glass Works' components exhibited a radon removal efficiency of 99.3 percent using a 125 ml flask, but the 30 ml bubblers constructed with Consolidated Glass Works' components yielded a removal efficiency of only 89.6 percent. When 200 ml and 300 ml flasks were used with the same bubblers, removal efficiencies of 93.0 percent and 97.6 percent were obtained. Flasks larger than 300 ml were not considered as they are too unwieldy for mass sampling.

Removal efficiencies obtained with the 45 ml and 60 ml modified bubblers were 99.5 percent with 125 ml flasks. This indicates that removal efficiency is more dependent upon bubble size than flask size or sample volume.

Efficiency Determination

To determine the difference in counting efficiency between flasks with open bottoms and those with zinc sulfide coated bottoms, groups of flasks of both types were prepared. Although no significant difference in counting efficiency was noted, one distinct disadvantage of complete coating was found. The counting efficiency appeared to depend more heavily on the zinc sulfide thickness. Because of the scattered values of counting efficiency obtained with coated bottoms, it was concluded that uncoated flask bottoms produce more consistent and reliable results.

The adhesive used to hold the zinc sulfide to the flask walls during the field sampling program was a solution of silicone oil in chloroform. As the flasks had to be recoated many times, it was important to decontaminate them after each use. Removing silicone oil from the walls with a solution of detergent

* Using Corning Glass Works' components.

in chloroform proved to be time-consuming.

As an alternate, petroleum jelly was tried with some success, both in solution with a fast drying solvent and directly. Removing this ZnS adhesive from the flask walls by scrubbing with a detergent was somewhat easier, but still required much time. K-Y Sterile Lubricant, advertised as a water-soluble lubricant, was also tried as a coating agent for zinc sulfide. It proved to be lumpy and difficult to apply smoothly. Efforts to dissolve this lubricant to overcome this difficulty were unsuccessful.

It was concluded that the solicone oil possesses the most suitable combination of characteristics. However, Vaseline was found to be an adequate substitute.

A number of different zinc sulfide phosphors were used. The requirements for a suitable phosphor are that (1) the persistency be short and (2) the particle size be large enough to eliminate any tendency to lump. DuPont Luminescent Chemical, Type D, was used for most of the field work and proved very good.

The Radelin Phosphors, produced by the U.S. Radium Corporation, were most extensively evaluated. Only 272B proved to possess completely desirable properties and is recommended for future use.

Sampling and Analytical Techniques

The sampling and analytical procedures have become standardized into a system emphasizing speed, while preserving accuracy. The analysis involves the colection of a water sample with minimum aeration, removal and collection of the radon from the water, and analysis by scintillation counting.

Bubbler and Scintillation Flask Preparation

After cleaning, the bubbler was prepared for sampling by adding one ml of concentrated nitric acid through the tapered joint to produce an approximate 0.5N acid concentration in the sample. The low pH of the resulting solution tends to keep materials in solution and reduces contamination of the bubbler. The final step is to weigh the bubbler for determination of sample volume.

Scintillation flasks became contaminated by radon daughters after each radon sample with a concentration above 500 $\mu\mu$c/l and had to be washed and recoated. To conserve flasks and to maintain fresh zinc sulfide coatings, each flask was first used for a background count, then for a sample, and finally recoated. The silicone grease layer prevented contamination of most of the surface of the flask, and no permanent increase in flask activity was noted.

Sample Collection

Samples were collected directly from faucets to measure the true radon concentration exposure. Before collecting a sample, the faucet was allowed to run for a period of at least one minute to insure that the sample came from the pressure tank or the well. Since radon tends to escape quite readily, any turbulence in the flow from the faucet would result in a partial loss of radon. To minimize this error, aerators and spray nozzles were removed, and a

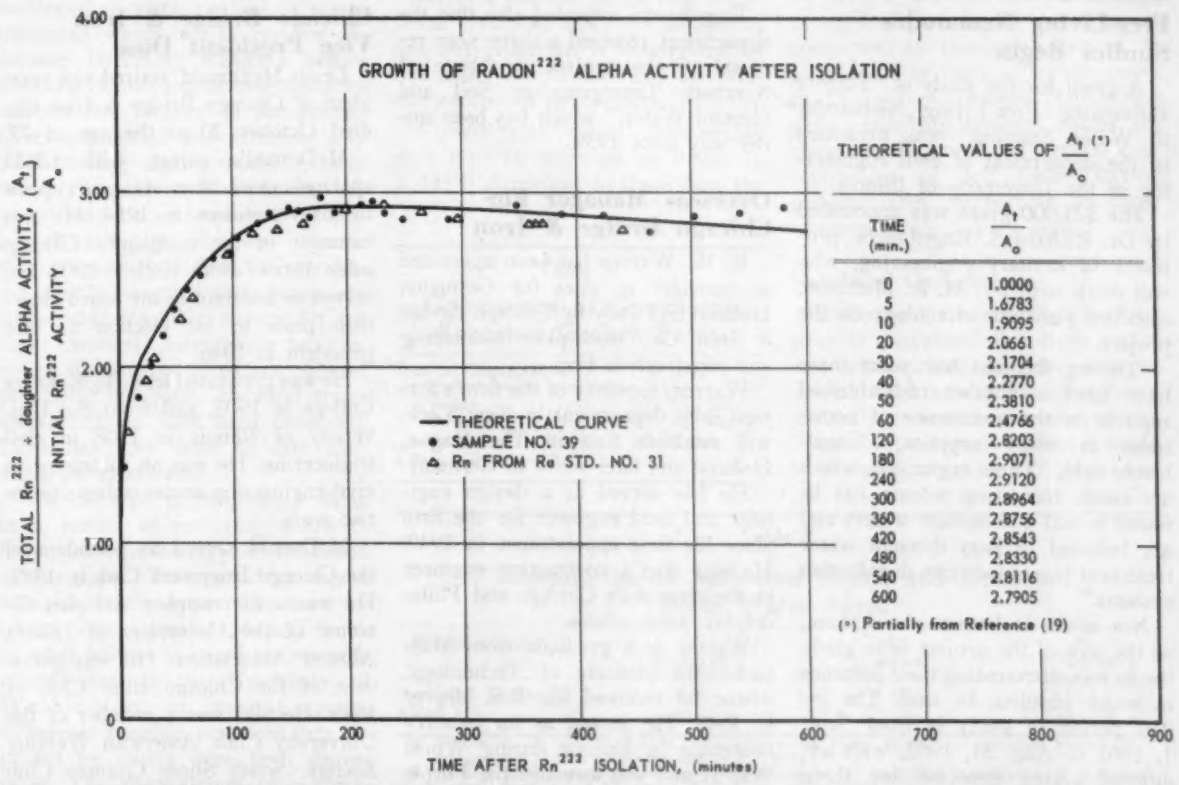


FIG. 4. GRAPH DEPICTING Growth of Radon^{222} Alpha Activity Isolation.

uniform and smooth flow of water was obtained from the faucet. The bubbler was filled directly under the stream, quickly removed and stoppered.

Radon De-emanation

Radon was removed from the bubbler and collected in the scintillation flask. The upper capillary tube of the bubbler was connected to the scintillation flask. The rubber tube clamp and upper stop-cock of the bubbler were opened, while the second stopcock was used to regulate the "vacuum-produced" flow of air. After bubbling had ceased during separation, a partial vacuum remained in the scintillation flask because of head loss in the flow of air through the bubbler. This loss is proportional to the porosity of the fritted glass plate and to the depth of the water sample in the bubbler. Consequently, the remaining vacuum varied with different sample depths and bubbler porosities. Since the range of alpha particles in air is a function of the air density, the proportion of alpha particles reaching the ZnS in the scintillation flask would vary with the partial vacuum. To maintain a more constant counting efficiency, the pressure in the flask was equalized to atmospheric pressure in each case.

Air was used to remove the radon from the water. Therefore, special measures were necessary to correct for the radon concentration of the air. The problem was overcome by taking an air sample at each radon sampling point. The "air sample" flask count provided the background for calculations.

Laboratory Analysis for Radon

The analysis of samples proved to be rapid and simple. The bubblers were reweighed to determine the sample volume. The sample and background flasks were counted to complete the analysis.

Special care was necessary in two steps of the laboratory analysis. First, the flask should be centered on the photomultiplier tube to insure constant geometry. Second, it was necessary that the sample be separated at least four hours before counting started. As may be seen from Figure 4, this time interval insures that the radon and daughters are in equilibrium. No correction for decay during counting was necessary, over normal counting periods, because of the slow rate of change in the total activity.

De-emanation Method for Radium Analysis

The method of analysis for radon was adapted to radium by minor changes in procedure. However, because of the low concentrations of radium normally present in natural waters and the small sample capacity of the bubblers, the accuracy of the radium analysis was relatively poor unless high radium concentrations were encountered.

The procedure for radium analysis involved storing a water sample for a known length of time to allow the build-up of radon from radium, followed by a determination of the radon content. After weighing, to determine the sample volume, the sample and bubbler used for the analysis of radon were used for the determination of radium. The exact analytical procedure was outlined in detail previously.[3]

References will be included at the end of Part 3.

Free-Living Nematodes Studies Begin

A grant for the study of "Factors Influencing Free-Living Nematodes in Water Supplies" was presented to the department of civil engineering of the University of Illinois.

The $21,000 grant was announced by Dr. Richard S. Engelbracht, professor of sanitary engineering, who will work with Dr. M. R. Matteson, associate professor of zoology on the project.

"During the past few years there have been a number of published reports on the occurrence of nematodes in water supplies," Engelbrecht said. "These organisms, which are small, free-living worms, can be found in soil and surface waters and are believed to pass through water treatment plants into city distribution systems."

Not much is known about them, so the aim of the project is to study the factors surrounding their presence in water supplies, he said. The initial period of study is from Sept. 1, 1961 to Aug. 31, 1962, with additional grants expected for three years.

Engelbrecht indicated also that the department received a three year renewal of the project on "Fate of Synthetic Detergents in Soil and Ground Water," which has been under way since 1959.

Overseas Manager For Chicago Bridge & Iron

R. W. Warren has been appointed as manager of sales for Germany, Holland and Italy by Chicago Bridge & Iron Co., steel plate fabricating and construction firm.

Warren, formerly of the firm's foreign sales department in New York, will establish first in The Hague, Holland and later move to Germany.

He has served as a design engineer and field engineer for the firm since his first appointment in 1949. He was also a contracting engineer in the company's Chicago and Philadelphia sales offices.

Warren is a graduate from Massachusetts Institute of Technology, where he received his B.S. degree in 1949. He served as an infantry lieutenant in Europe during World War II and was awarded the Purple Heart and two Bronze Star medals.

Chicago Bridge & Iron Vice President Dies

Lewis McDonald, retired vice president of Chicago Bridge & Iron Co., died October 20 at the age of 77.

McDonald's career with CB&I spanned more than 44 years prior to his retirement in 1954. He was manager of the company's Chicago sales district from 1921 to 1931 and served as assistant to the board chairman prior to his election as vice president in 1946.

He was graduated from McKendree College in 1905, and from the University of Illinois in 1908 in civil engineering. He was an instructor in civil engineering at the university for two years.

McDonald served as president of the Chicago Engineers Club in 1939. He was a life member and past director of the University of Illinois Alumni Association. He was president of the Chicago Illini Club in 1949. He also was a member of the University Club, American Welding Society, South Shore Country Club and Beverly Country Club.

RESEARCH PROGRESS REPORT

Algae Aid in Sewage Nutrient Removals

by PROF. R. H. BOGAN
Dept. of Civil Engineering
University of Washington
Seattle, Washington

■ EXCESSIVE ENRICHMENT or eutrophication of receiving waters by nutrient rich wastes is emerging as a major water pollution problem in many areas. It has been recognized for some time that ordinary domestic sewage is a rich source of the nutrients required by phytoplankton. Experience has shown that the degree of eutrophication and, hence, the severity of subsequent water quality problems is dependent largely upon the supply of inorganic nitrogen and phosphorus.

From time to time, interest has developed in some method of waste treatment which would remove offending fertilizing elements before discharge. Limnological investigations indicate that removal of phosphorus offers a practical and effective way of controlling algal growths in most natural waters[7]. Phosphorus removal may be accomplished by biological and by chemical means. Either approach is aimed at converting soluble inorganic phosphorus into recoverable insoluble matter. Of the two, chemical coagulation has received the greatest attention. Several promising but costly chemical treatment methods have been proposed. Little has been done to date with biological treatment.

The concept of employing algae as a means of removing nutrients from domestic sewage is examined in this paper. This particular aspect of algal activity appears to have received little attention; hence, much of what follows is based on research carried out at the University of Washington in recent years. Wherever possible, pertinent data reported by others have been drawn upon. The development of a treatment process employing a photosynthetic operation is briefly described and discussed.

Theoretical Concepts

Biological Uptake

The concept of removing nutrients by biological means can hardly be considered as new or unique. In any actively growing biological system, nutrient materials are continually extracted from the environment through conversion to cell tissue. Rate of nutrient removal, other things being equal, is a function of the rate of cell tissue synthesis, while the amount of nutrient reduction is determined by cell tissue composition and the mineral content of the medium.

Growth rate varies considerably with type of organism as shown in Table 1. According to these data, the mixed bacterial culture provided by activated sludge would appear to be the most effective biological system in terms of removal rate.

Examination of the data presented in Table 2 indicates that assimilation of mg/l of phosphorus would be accompanied by the metabolism of 25 to 50 mg/l or more of carbon and 2 to 12 mg/l of nitrogen. Theoretical daily phosphate removal values are shown in Figure 1 for several concentrations of cell tissue having growth rates comparable to those commonly reported for algae.

Table 1

Comparison of Commonly Reported Growth Rates

Type of Organization	k[a] (day^{-1})
Algae	0.20 to 2.0
Protozoa	1.0 to 4.0
Bacteria	2.0 to 60

a Based on $N_t = N_o e^{kt}$

Nutritional Limitations

Ordinary domestic sewage does not provide a balanced diet. Both carbon and nitrogen are deficient with respect to the amount of phosphorus normally present. In the case of activated sludge, organic carbon is usually limiting. Agricultural grade am-

Table 2

Composition of Activated Sludge and Common Fresh Water Algae

Biological System	C % dry wt.	N % dry wt.	P % dry wt.
Activated Sludge [a,b]	41-53	8 - 12	0.7 - 2.2
Algae [c]	49-70	1.4 - 11	0.9 - 2.0

a. Hoover, S. R., and Porges, N., "Assimilation of Dairy Wastes by Activated Sludge—II," Sewage and Industrial Wastes, 24, 306 (1952)
b. Helmers, E. N., et.al., Nutritional Requirements in the Biological Stabilization of Industrial Wastes", Sewage and Industrial Wastes, 24, 496 (1952)
c. Carnegie Institute of Washington, Publication 600, *Algal Culture from Laboratory to Pilot Plant*, R. W. Krauss, Chapter 8, 1953

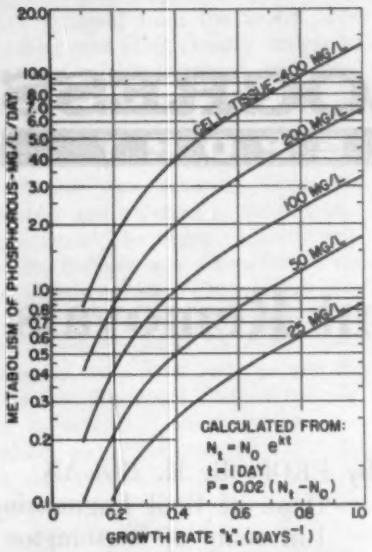


FIG. 1. THEORETICAL RELATIONSHIP between cell tissue concentration, growth rate and metabolic conversion of phosphorous by algae.

monia nitrogen could be made to serve as an economical source of supplemental nitrogen. In most situations the cost of supplying adequate organic carbon would be prohibitive.

Algae do not suffer from the same dietary restrictions as activated sludge. Adequate amounts of carbon are normally available in the form of alkalinity. The inorganic nitrogen supply may still be limiting. Atmospheric nitrogen fixation might be made to serve as a significant source of nitrogen in large scale algal cultures[7]. Viewed in terms of nutritional requirements, algae appear to offer the most easily exploited biological system for extracting phosphorus from domestic sewage.

Observed Phosphorous Reductions

Significant amounts of phosphorus should, of course, be removed during conventional biological sewage treatment. Based on a carbon to phosphorus ratio of 100 to 1 and a settled raw sewage BOD in the range of 100 to 200 mg/l, it becomes obvious phosphorus reductions during the course of biological sewage treatment would on the average be limited to about 1 to 2 mg/l. Owen[6], in an investigation of sewage treatment plant performance in Minnesota, found phosphorus removals ranged from an average 2 percent for primary treatment plants to an average 23 percent for plants employing biological treatment; this was equivalent to approximately 1 to 2 mg/l of P. Analysis of biological sewage treatment plant effluents in the Seattle area disclosed a reduction ranging from 15 to 40 percent which was equivalent to 0.80 to 2.0 mg/l of P.

The general role of algae in sewage treatment has received considerable attention in recent years. Many excellent reports have appeared in the literature dealing with algal behavior in oxidation ponds and raw sewage lagoons[1, 4, 5, 8]. Unfortunately, little data have been reported regarding nutrient reductions realized in such processes. Attention appears to have centered mainly upon the concept of using photosynthetic oxygen production. Available information indicates phosphorus reductions ranging from 10 to 90 percent or better. Performance appears to be erratic and unpredictable. Considerable difficulty has been experienced in harvesting algal cell tissue; this coupled with slow growth rate probably accounts for some of the wide fluctuations noted in the mineral composition of lagoon effluents.

Use and Recovery of Algae

The most direct method of employing algae as a means of recovering nutrients would appear to be in oxidation ponds followed by a process for harvesting algae. With such an arrangement, sewage would be continually mixed with actively growing algae and the nutrients gradually converted to cell tissue. Algae would be recovered for reuse or wasted according to need. Experience indicates the principal problem would be that of harvesting the algae.

A number of methods have been investigated for harvesting algal cell tissue[1]. All have been found wanting in some aspect, generally in terms of efficiency, often in terms of cost. From the standpoint of all around performance and economy, some type of screening device would appear to be the most promising separation operation.

Screen performance obviously would be related to the nature of the algal culture. It was reasoned, however, that if a readily recovered algal species could be established, then through the simple mechanism of recovery and reuse it could, in turn, be made to predominate. Other things being equal, the process would naturally tend to contain the most readily utilized population. The ideal organism appears to be a large rapidly growing filamentous alga. There is little evidence that filamentous species of the type desired normally grow in oxidation ponds or sewage lagoons. This does not preclude the possibility of their being cultivated under such conditions. Filamentous species fail to constitute a significant part of the population of most oxidation ponds. This may be because they are relatively slow growers and tend to be over-grown by rapidly multiplying species such as *Chlorella* and *Scenedesmus*.

Experimental Results

Early experimental efforts were influenced by the concept of establish-

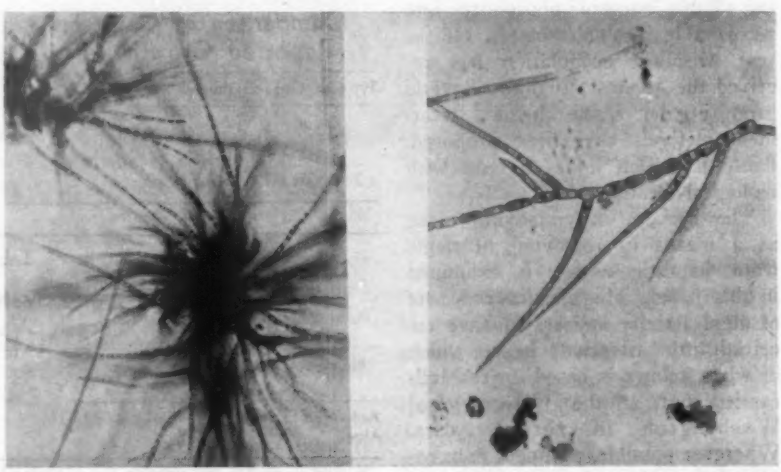


FIG. 2. PHOTOMICROGRAPHS of *Stigeoclonium stagnatile:* (left) shows floc colonies which developed in aerated cultures, 220x; (right) view of individual organism, 320x.

Table 3

Effect of Temperature and Culture Media on Growth Rate, Stigeoclonium stagnatile[a]

Temperature °C	Synthetic Sewage Employing NO_3—N	Synthetic Sewage Employing NH_3—N	Secondary STP Effluent
	k $days^{-1}$ (c)	k $days^{-1}$ (c)	k $days^{-1}$ (c)
10	0.165	0.140	0.170
15	0.188	0.179	0.215
20	0.252	0.131	0.131 (b)

a. pH varied from 8.3-9.5, illumination was at 400 f.c.
b. *Scenedesmus* appeared and began to predominate after approximately 15 days
c. k computed from $N_t = N_o e^{kt}$

ing and utilizing unique algal species. A large part of this investigation was concerned with the mechanisms by which algae removed phosphorus from solution. Attention subsequently centered upon development and evaluation of a high rate phosphorus removal process. Space does not permit a detailed accounting of all major aspects of this research. There follows a brief summary of some of the more significant findings dealing with the topics of available algae, mechanism of phosphorus removal, physical chemical behavior of orthophosphate, photosynthetic pH adjustment, and cell tissue recovery.

Available Algae

Several common fresh water algae were grown in the laboratory on mixtures of lake water and raw and treated sewages. However, except for *Chlorella* and *Scenedesmus* most species gradually died out after a brief period of active growth. A large filamentous alga, subsequently identified as *Stigeoclonium stagnatile* was recovered from the rock of a biological filter in the area and successfully cultured. This alga when grown under aeration developed into settleable floc particles resembling activated sludge. Photomicrographs of *Stigeoclonium stagnatile* are shown in Figure 2. Its growth characteristics and nitrogen and phosphorus content are shown in Tables 3 and 4.

Mechanism of PO_4 Removal

Phosphorus removal was expected to follow a pattern predicted by cell tissue composition and growth rate, see Figure 1. Contrary to expectations, orthophosphate residuals in batch fed cultures were found to decrease at a rate considerably in excess of that predicted by biological uptake. Response to repeated heavy phosphate doses was most interesting; in general, some 80 to 90 percent of the phosphate added was removed from solution within two hours, as shown in Figure 3. Obviously more than metabolic uptake was involved. Examination of culture characteristics disclosed phosphorus removal was related to pH. It thus appeared that coagulation and adsorption may have played a significant role.

At moderately high pH levels, generally in the range of 9.5 to 10.0, large amounts of phosphorus were extracted rapidly from solution without the use or need of auxiliary chemicals. At lower pH levels, the rate of phosphorus removal should of course be determined largely by algal growth rate. This hypothesis was subsequently tested in the laboratory and in the field. Laboratory pilot plant performance is shown in Figure 4. At pH levels of 9.5 and above, field cultures exhibited phosphate reductions comparable to those observed in laboratory batch and pilot plant studies.

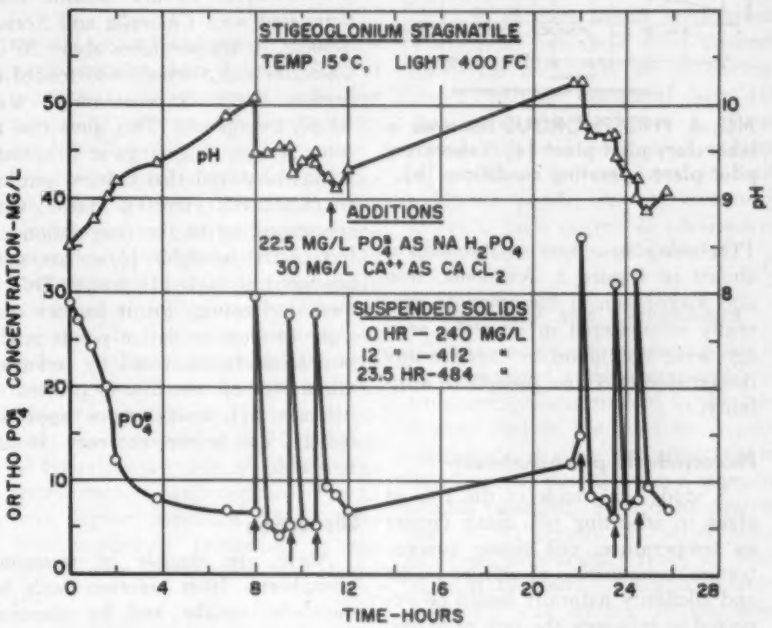


FIG. 3. RESPONSE OF BATCH fed algal cultures to repeated doses of PO_4.

PO_4 Behavior

Under suitable conditions, orthophosphate may combine with a number of substances commonly present in sewage to form relatively insoluble complexes. Calcium ion concentration and pH were found to be the principal controlling factors in determining

Table 4

Phosphorus and Nitrogen Content of Stigeoclonium stagnatile Harvested from Various Culture Media[a]

Constituent	Synthetic Sewage NO_3—N	Synthetic Sewage NH_3—N	Secondary STP Effluent	½ STP Eff. ½ NO_3—N Syn Sew.
N	5.71	6.59	6.52	6.00
P	2.16	1.81	1.89	2.07
N/P	2.64	3.63	3.44	2.89

a-Expressed as percent dry cell weight. Values reported represent an average of several determinations.

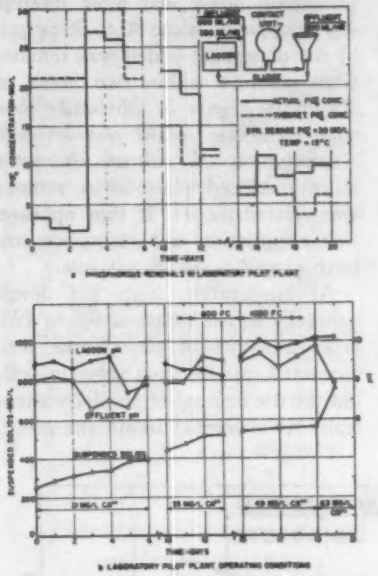


FIG. 4. PHOSPHOROUS removals in laboratory pilot plant (a). Laboratory pilot plant operating conditions (b).

PO_4 solubility; their relationship is shown in Figure 5. Ammonia, iron and magnesium in the amounts generally encountered in domestic sewage were not found to exercise any discernable effect on phosphate solubility.

Photosynthetic pH Adjustment

A study was made of the role of algae in adjusting pH. Such factors as temperature, cell tissue concentration, composition of culture media and alkalinity naturally would be expected to influence the rate of photosynthetic pH adjustment. Interestingly, light intensity was found to be the principal rate controlling factor. Photosynthetic pH response under carefully controlled laboratory conditions and under field conditions is shown in Figure 6 and Table 5. Where light was not limiting, pH response followed a pattern such as that shown in Figure 6. Under field conditions light intensity became limiting and the rate of change of pH was consequently markedly reduced.

Judged solely on the basis of rate of pH adjustment, minimum light intensity requirements appear to lie in the vicinity of 100 to 200 f.c. Where such light intensities are possible, the pH of raw and treated sewages may be photosynthetically increased to 9.0 and above within 4 to 12 hours.

Cell Tissue Recovery

When it was found that *Stigeoclonium stagnatile* could be effectively recovered by sedimentation, the concept of employing a screen for cell tissue recovery was abandoned. Repeated use of a *stigeoclonium* culture, such as during successive batch feedings or during cell tissue recycling in pilot plant operations, resulted in marked improvement in settling characteristics. It appeared that adsorption of insoluble calcium phosphate salts by the algae caused coagulation of cell tissue, thereby increasing its rate of subsidence.

During pilot plant studies, the *Stigeoclonium culture* became contaminated with *Chlorella* and *Scenedesmus*. At temperatures above 20°C, *Chlorella* and *Scenedesmus* tended to predominate; *Stigeoclonium* was simply overgrown. This gave rise to some serious misgivings at first until it was observed that culture settling characteristics varied little with species owing to the coagulation effect of the insoluble phosphate salts produced at high pH levels. This is most interesting, for it implies that algae in most oxidation ponds might be effectively recovered by sedimentation if they are first permitted to increase pH levels above approximately 9.5 before recovery is attempted.

Discussion

Algae are capable of removing phosphorus from solution both by metabolic uptake and by chemical coagulation and adsorption. Adsorption and coagulation appear to play

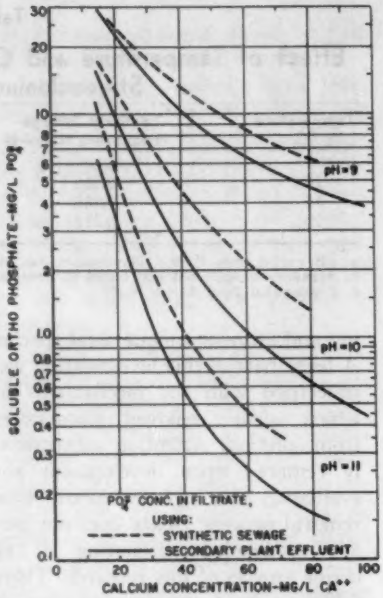


FIG. 5. INFLUENCE OF pH and calcium concentration on orthophosphate solubility.

the major role where rapid removal of large concentrations of phosphorus is involved. The relative significance of biological uptake depends, of course, on algal growth rate, environmental conditions, and upon time available for growth. In either case, it is the photosynthetic activity of the algae which governs the rate of removal.

High Rate Process

Laboratory pilot plant studies employing an illuminated contact unit followed by sedimentation have demonstrated that a high rate continuous

Table 5

Photosynthetic pH Changes in Lagoon Cells—Autumn 1958

Time-Days Lagoon Cell	1	2	3	5	7	10	12	15	Remarks
1	7.7	7.6	8.4	8.7	8.5	9.4	9.5	10.1	Intermittent aeration plus artificial illumination (400 F.C.) p.m. Int. Aeration: no artificial illum.
2	8.0	7.7	8.4	8.8	8.9	9.2	9.2	8.6	
3	8.1	9.0	8.5	9.1	9.3	9.7	9.7	10.4	No aeration; no artificial illum.
4	8.1	7.5	8.2	10.4	—	—	—	—	Int. aeration. Air off after day 6.
Time	1:30 p.m.	11:00 a.m.	11:00 a.m.	11:30 a.m.	3:00 a.m.	11:30 p.m.	10:30 a.m.	12:00 N	All lagoon cells filled with secondary treatment plant effluent and seeded with equal volume of algal culture
Weather	Cldy	Cldy	Pt. Cldy	Rain	Sunny	Pt. Cldy	Sunny	Sunny	
Temperature °C	—	—	14	—	12	11	10	11	
Susp. Solids mg/l	—	28	33	36	36	62	62	70	

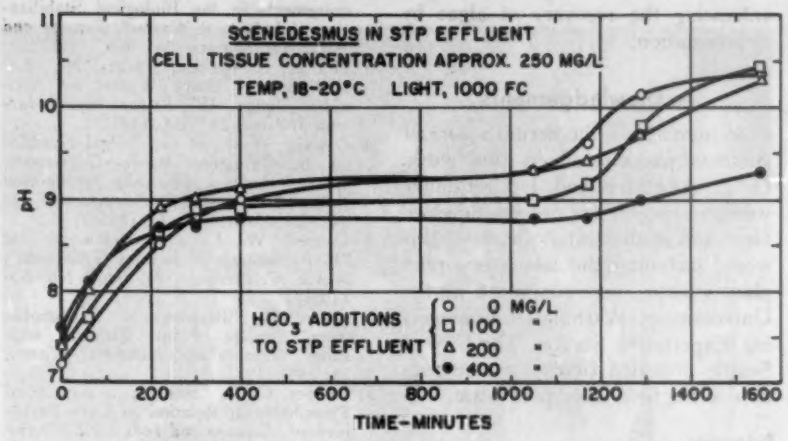


FIG. 6. INFLUENCE OF HCO_3 concentration on photosynthetic pH shift.

flow process is functionally feasible when light is not limiting. Orthophosphate concentrations can be reduced to less than 1 mg/l within 6 to 12 hours. This is equivalent to a 90 to 95 percent reduction in the phosphorus content of most sewages. Residual phosphate concentrations of about 3 to 5 mg/l were realized with contact times as brief as 2 to 4 hours.

While a high rate algal treatment process appears to be functionally sound, economic considerations restrict the use of algae to the more leisurely conditions prevailing in oxidation ponds and sewage lagoons. Process costs are related to the cost of pH adjustment which, in turn, is a function of light requirements and hold-up time. Where artificial illumination is employed, power requirements and hence, cost, can be computed from a knowledge of lamp performance and the rate of light attenuation in the algal culture. Cost of pH adjustment employing artificial and natural illumination is compared in Figure 7 together with the cost of pH adjustment by lime alone. Lime requirements were computed from titration curves of a number of treated sewages in the Seattle area. Economical considerations appear to preclude the use of artificial illumination.

Lighting Limitations

Owing to a high rate of light attenuation, it is exceedingly difficult to maintain adequate illumination in large scale cultures. Theoretical considerations based on the Beer-Lambert Law indicate that it ordinarily would not be possible to maintain light intensities above 100 f.c. by natural or artificial means in depths much greater than 1 foot. Current practice is to construct oxidation ponds and lagoons with depths ranging from 3 to 5 feet.

As a practical matter, where thorough mixing occurs, the effect of employing depths greater than that involved in photosynthesis is roughly equivalent to illuminating the entire culture at a proportionately lesser intensity. The net photosynthetic response is thus reduced and a longer contact time must be provided to achieve a given degree of pH adjustment. For example, it was found that 12 hours contact time at 100 f.c. was approximately equivalent to 10 to 12 days lagoon retention time under field conditions prevailing in the Seattle area during the fall of the year.

Detention Time Requirements

Theoretically, an oxidation pond should be capable of very high efficiencies of phosphorus removal. In order to realize this potential, active photosynthesis and/or high pH conditions must prevail for some time prior to discharge. Where biological fixation is the principal mode of phosphorus removal, efficiency will be a function of detention time, growth rate, and cell tissue concentration.

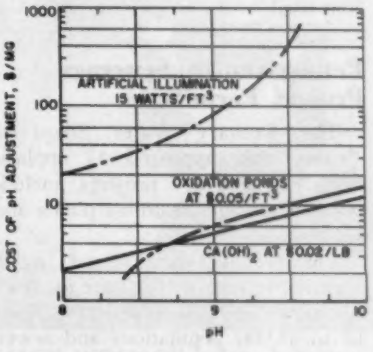


FIG. 7. ECONOMIC COMPARISON of various methods of adjusting pH.

During field pilot plant studies algal cell tissue concentrations in lagoon units having a depth of 3 to 4 feet varied from 25 to 50 mg/l. Average growth rate was equivalent to a k of 0.30 day^{-1}. Thus, in order to biologically extract 5 mg/l of P, equivalent to 80 to 90 percent reduction for most sewages, it appears lagoon retention times on the order of 14 to 28 days would be required. Theoretical retention time requirements for any other set of circumstances can be calculated from the data presented in Figure 1. These considerations suggest pond volume in excess of that employed in most oxidation ponds may be necessary where a high degree of phosphorus removal is a treatment objective.

Summary and Conclusions

The concept of employing algae as a means of removing phosphorus from sewage was studied in the laboratory and in the field on a pilot plant scale. A high rate process was developed in the laboratory whereby soluble phosphate reductions equivalent to 90 percent or better were achieved with contact times as brief as 6 to 12 hours. The process subsequently was studied in the field along with the behavior of conventional sewage lagoons. Certain aspects of this work were discussed in this paper and are briefly summarized.

1. In the presence of adequate amounts of light, it is possible to realize rapid biological extraction of phosphate. Minimum light requirements appear to be in the vicinity of 100 to 200 f.c.

2. Under normal field conditions adequate light intensities seldom prevail in algal cultures at depths much in excess of 1 foot. The use of deeper ponds, as is common practice today, serves in effect to decrease net illumination roughly in proportion to the ratio of light and dark volumes. Photosynthetic reaction times are markedly increased.

3. Adsorption and coagulation ap-

pear to play the major role where rapid removal of large amounts of phosphate is involved. Metabolic conversion is the principal removal mechanism under the more leisurely conditions prevailing in oxidation ponds and sewage lagoons. In the latter case, efficiency of phosphate removal is proportional to detention time, other things being equal.

4. Three algae, *Chlorella, Scendesmus,* and *Stigeoclonium* were grown in raw and treated sewages. Repeated reuse of these algae generally improved subsidence properties without noticeably impairing photosynthetic response. Settleability appeared to be influenced by the formation of insoluble phosphates at elevated pH. It appears that the photosynthetic pH shift may be employed as a means of enhancing the recovery of algae by sedimentation.

Acknowledgements

A number of the writer's former students participated in this work. O. E. Albertson and J. C. Pluntze were responsible for process development and study. Initial phases of this work, including the laboratory pilot plant studies, were supported by the University of Washington Engineering Experiment Station. The City of Seattle provided funds for construction of the field scale pilot plant.

References

1. Carnegie Inst. of Washington, Publication 600, Algal Culture from Laboratory to Pilot Plant, Washington, D.C., (1953).
2. Helmers, E. N., et. al., "Nutritional Requirements in the Biological Stabilization of Industrial Wastes", *Sewage and Industrial Wastes,* 24: 496, (1953).
3. Hoover, S. R., and Porges, N., "Assimilation of Dairy Wastes by Activated Sludge—II", *Sewage and Industrial Wastes,* 24: 306, (1952).
4. Oswald, W. J., et al., "Algal Symbiosis in Oxidation Ponds—II Growth Characteristic of *Chlorella pyrenoidosa* Cultured in Sewage", *Sewage and Industrial Wastes,* 25: 26, (1953).
5. Oswald, W. J., and Gotaas, H. B., "Photosynthesis in Sewage Treatment", ASCE Proceedings, 81, Sept. No. 636 (1955).
6. Owen, R., "Removal of Phosphorus from Sewage Plant Effluent with Lime", *Sewage and Industrial Wastes,* 25: 548, (1953).
7. Sawyer, C. N., "Some New Aspects of Phosphates in Relation to Lake Fertilization", *Sewage and Industrial Wastes,* 24: 708, (1953).
8. University of Texas, Civil Engineering Department, Development of Design Criteria for Waste Stabilization Ponds, Final Report to the AEC, (March 1, 1957).

Desert Missile Center Meets Water Problem

Water is a precious commodity in a desert. The Army at White Sands Missile Range, N. M., has to dig deep for its supply. It has a pipe network which, if laid end to end, would stretch 100 miles.

The water source at the center, with its more than 10,000 employes and 5,000 residents, lies 1,000 ft below layers of rock and sand.

Eight deep wells, semi-circling the post, provide more than 600-million gallons of water a year. A net of pipes, fingering out into the desert 20 miles, carries water to range instrumentation stations and to family quarters.

Due to the expansion of the range the past few years, water requirements have almost doubled. To meet demands, seven wells pump an average of 3,500 gallons a minute to a 2,425,000 gallon storage complex.

"Two wells are equipped with 800 gpm capacity pumps and five have 650 gpm pumps. The well at the Small Missile Range only operates part time at 480 gpm," said Thomas Yarbrough, chief of sanitation section, Post Engineers.

The wells are housed in cinderblock buildings and each has a turbine pump with a connection pipe extending downward. Water is sent to a giant-size sand-trap where it goes through a settling process, then to storage tanks. As water is moved to the distribution system, chlorine is applied.

"We only use about three-quarters of a pound of chlorine to treat a million pounds of water to meet necessary requirements," Yarbrough said.

A central booster station is the nerve center of the WSMR water system. An automatic control board flashes light signals when the water in storage tanks drops to "emergency level". At the same time, a light flashes at the Post Fire Station.

In addition to requirements for household use, fire protection, air conditioners for office buildings, laboratories and sensitive range instruments, water is used in direct support of particular phases of missile programs such as static motor tests and missile fueling.

"During the 1960 fiscal year, a total of 610,441,850 gallons were used on post and at the south range facilities," Yarbrough said. "June 1960 was the peak month with some 83,614,000 gallons used."

Pennsylvanian Sewerage Project Permits

The Sanitary Water Board of Pennsylvania approved 41 applications for sewerage projects, including new sewage treatment plants and sewers.

The permits were issued in 21 counties throughout the state for sewage treatment plants servicing from 12 to 45,000 populations and sewer extensions serving from 17 to 12,000 persons.

Wisconsin Sewage Plant Chemist Honored

Henry M. Heisig, retired chemist of the Milwaukee Sewage District, was recipient of the George F. Bernauer Memorial Award from the Water Pollution Control Federation, October 11.

The award is given by the Conference of Wisconsin Sewage Works Operators for "Exceptional Contribution in the Field of Waste Water Technology."

A-C Compressor to be Used in Pilot Model Saline Water Conversion Plant

A pilot saline water conversion plant being constructed by Rocketdyne, a division of North American Aviation, Inc., Canoga Park, California, will include a "C" style, ball bearing pedestal type, single-stage Allis-Chalmers centrifugal compressor with a special water buffered bushing seal.

The compressor is driven by an open, epoxy-resin insulated Super-Seal motor through a speed increasing gear.

The pilot plant, being erected near Oxnard, California, will produce 15,000 to 20,000 gallons of fresh water daily and will cost approximately $250,000 to build.

The North American process reportedly will convert sea water at a cost of 40 cents per 1000 gallons of water at a production level of 10 million gallons.

EQUIPPED WITH a safety line, and M-S-A hose mask and Maskfone, a San Antonio municipal employee prepares to check a storm sewer.

Civil Defense Program Uses Sound-Powered Mask

by JAMES F. WOLFE
Ketchum, MacLeod & Grove, Inc.
Pittsburgh, Pa.

■ ONE OF THE handicaps of an adequate Civil Defense program is the problem of almost every public agency—lack of funds. Because there never seems to be enough money to go around for all the things that need doing, Civil Defense has often had to "make do" with what is available.

Within this framework of "make do," a great deal has been accomplished. In San Antonio, Tex., for instance, Civil Defense Co-ordinator Martin Eser said: "We have two principal problems—personnel and equipment. We are always at work to secure more of both, and it is surprising what we have done simply by incorporating into our program what is already available."

When Mr. Eser, formerly a city fire department inspector, assumed his present post several years ago, he began co-ordinating fire fighting forces with CD activities. Similarly, his deputy, Jack Larned, a police lieutenant, brought the law enforcement organization into the program. Scouring remaining departments of municipal government, and also private industry, they utilized other specialized people and equipment. This process is still going on. The inventory of emergency services available is expanding considerably.

Civil Defense, working with other agencies, has rendered a double service in San Antonio. Often, when a municipal agency cannot justify equipment acquisition, and when Civil Defense cannot justify it, the two together *can* justify purchasing.

Respiratory Protective Equipment Purchased

Such was the case when breathing and testing apparatus, to be used in areas where air might be contaminated, was recently purchased. Mr. Eser, working closely with Public Works Director Sam Granata, learned this equipment was needed in the Sewer Maintenance Division. He knew it could also fill a gap in his Civil Defense equipment ranks. A proposal was submitted and accepted to purchase a hose mask, a Maskfone*, and six combustible gas indicators.

The utility hose mask supplies complete respiratory protection in oxygen deficient areas or where there is any degree of atmospheric contamination. The Maskfone is a sound-

* Product of Mine Safety Appliance Company.

MACK WOMACK, safety inspector; Eddie Klaus, lift station supervisor; and David E. Koch, safety director (left to right) check out a Maskfone available for Civil Defense and public works service.

THE MASKFONE on this hose mask is a sound-powered wire unit designed for direct voice contact in areas where toxic gases may present a hazard. San Antonio's Sewer Maintenance Division employs equipment of this type in regular maintenance work and also makes it available to Civil Defense workers for emergency duty training.

powered wire unit that maintains direct voice contact in areas where toxic gases may present a hazard. The combustible gas indicator is a self-contained, portable instrument for precise testing of explosive gas hazards.

This equipment is kept at the Sewer Maintenance Division warehouse, strategically located near the center of the city. Several crews have been thoroughly trained in its use, and these crewmen are registered with police and fire dispatchers for emergency duty.

In addition to availability of these crews for Civil Defense, they regularly maintain sanitary and storm sewers in San Antonio, population 600,000. In a closed sewer there is always a possibility of gas accumulation.

"We almost lost a man some time ago because we did not have breathing or atmosphere-testing appliances," Mr. Granata reported. "The primary danger is asphyxiation, but there is always the chance that a natural gas leak has permitted combustibles to accumulate in a sewer. Now, to minimize the danger, we survey a possible hazard area with the M-S-A Co. indicator. Workmen who make repairs are equipped with the hose mask and Maskfone.

"We're proud of our accident prevention record. We figure it's always a good idea to play it safe."

The equipment has not yet been used in a Civil Defense emergency, Co-ordinator Eser points out, "but we've had some close ones. A butane truck overturned on the highway near here, and, in Austin, they had a big natural gas pipeline leak not long ago."

About three years ago a tornado skirted San Antonio, doing light damage to a town 20 miles to the south. "We like to think we're out of the tornado belt," Mr. Eser relates, "but if one should hit, we'd likely need our Maskfone and combustible gas indicators. We did have a Conelrad alert on that one tornado."

THE SEWER Maintenance Division uses this combustible gas indicator to test for possible explosive gas hazards. This portable instrument is also available to Civil Defense workers.

CIVIL DEFENSE and other municipal agencies in San Antonio co-ordinate personnel and equipment for possible emergency service.

Reflecting on Civil Defense in general, Mr. Eser reported, "we're not ready—anywhere in the nation—for war, and we're not prepared for peacetime disaster. You can never really be as prepared as you ought to be. But I sleep easier nights, knowing we can lay our hands on an increasing quantity of specialized equipment and trained men and women."

THE HOSE MASK is designed for complete respiratory protection in oxygen deficient areas. The mask is equipped with a speaking diaphragm and Maskfone.

The Determination of Free Residual Bromine in Water

by A. T. PALIN, Chief Chemist
Newcastle and Gateshead
Water Co., Throckley, England

■ CHLORINATION OF WATER containing bromide and ammonia leads to the formation of monochloramine and monobromamine; such a condition may arise in the chlorination of sea water swimming pools or of water contaminated by sea water. Bromine itself may be used in place of chlorine for the disinfection of water in which case the need to determine free residual bromine may also arise in order to control the process.

Earlier work by Schaafsma[1] appeared to indicate that, in the presence of ammonia, bromine did not give rise to bromamines or other compounds containing "active" bromine. The more recent results of Johannesson[2] show, however, that formation of bromamines is possible. The fact that they behave with indicators, for example ortho-tolidine, in a manner similar to that of free bromine and free chlorine probably accounts for the previous, apparently erroneous, results.

With the Palin-FAS method using neutral ortho-tolidine indicator Johnannesson showed that monobromamine reacted as if it were free chlorine. Since free bromine also reacts as free chlorine the method would not therefore distinguish between free bromine and bromamines. These two forms could, however, be obtained separate from free chlorine by adding excess of an ammonium salt which, at a suitable pH, converts any free chlorine present to chloramine no longer giving a "flash" reading with the indicator.

In the Palin-DPD method using diethyl-p-phenylene diamine as indicator, bromamine also behaves like free bromine so that after conversion of any free chlorine to chloramine the reading obtained corresponds to free bromine plus bromamines and in this connection therefore the term "free bromine" is to be taken as meaning this total figure. As there do not appear to be the same differences in chemical and bacteriological behavior between bromine and bromamines as between chlorine and chloramines the need for their separate determination is not so important.

In systems containing free chlorine, chloramine (combined chlorine), and free bromine it is possible by a simple supplementary procedure to determine these constituents separately.

Since equivalent amounts of chlorine and bromine give the same color with the diethyl-p-phenylene diamine indicator the Palin-DPD method for determining chlorine and chloramines in water is easily adapted to give free bromine. The red color produced requires no stabilizing agents and interference is suppressed by using EDTA as a chelating agent.

Reagents Required

1. DPD Indicator Solution } or DPD powder (combined reagent)
2. Buffer Solution }
3. Ammonium Sulfate Crystals.
4. Potassium Iodide Crystals.

Five ml of each solution (1) and (2) are used per 100 ml sample. As these reagents are now available combined together in the form of a stable powder this, because of its greater convenience, is used in the procedure outlined below. Details of liquid reagent preparations have been previously reported[10].

Determination of Free Bromine

To 100 ml of sample add about 0.5 g DPD powder and mix. Immediately titrate any red color with standard FAS solution to a colorless end-point to obtain Free Bromine in terms of ppm chlorine.

Determination of Free Bromine, Free Chlorine & Combined Chlorine

In the presence of residual chlorine the reading obtained in the above procedure now corresponds to Free Bromine plus Free Chlorine (Reading No. 1). Then add 0.5 to 1 g of KI, mix and stand 2 min. Continue the titration with the FAS solution. (Reading No. 2). From this reading deduct reading No. 1 to obtain Combined Chlorine.

To a second 100 ml portion of sample add a small pinch of ammonium sulfate (about 0.05 g), mix to dissolve and allow to stand for about 1 min. Then add about 0.5 g of DPD powder, mix, and immediately titrate any color to obtain Free Bromine (Reading No. 3). Deduct this reading from reading No. 1 to obtain Free Chlorine.

If the determination of free chlorine and combined chlorine is not required but only that of free bromine itself, the use of potassium iodide is not required. It is necessary only to obtain Reading No. 3 using DPD powder and ammonium sulfate.

It may also be noted that the simple procedure given for Free Bromine using only DPD powder is applicable in cases where free chlorine is not expected to be present; any combined chlorine present does not interfere and in these circumstances the ammonium sulfate need not be used.

Notes

1. If required, a further refinement

may be introduced by making two separate additions of KI as in the full Palin-DPD procedure so giving a complete differentiation of a mixture of free bromine, free chlorine, monochloramine and dichloramine.

2. If the total concentration of available halogen is likely to exceed 4 ppm as chlorine take a smaller quantity of sample.
3. While it may be convenient to express the bromine results in terms of parts per million "chlorine" if it is desired to convert to "bromine" multiply the FAS readings by 2.25. In addition to the standard range of permanent color glasses for the DPD chlorine test two standard discs are now available calibrated in terms of bromine ranging from 0.2 to 2.0 and from 1.0 to 10.0 ppm.*
4. Dissolved oxygen in water can produce a faint color with the DPD reagent if allowed to stand. The suppression of trace metal catalysis by the EDTA incorporated in the reagent minimizes this effect and there is no interference within the period of the test.
5. The only interfering substance likely to be present in water is oxidized manganese. Its effect can be allowed for by the following procedure: Place one small KI crystal and 0.5 ml of 0.05 percent sodium arsenite ($NaAsO_2$) solution in titration flask. Add 100 ml sample and mix. Then add about 0.5 g DPD powder and mix. Any red color is titrated with the FAS solution and the reading subtracted from the readings of the above procedures for bromine and chlorine.
6. When using commercial colorimeters and comparators it has been found convenient, especially in the field, to use reagents in the form of standardized tablets.*

*Available from Tintometer Ltd., Salisbury, England.

References

1. Schaafsma, N.D.R., Water Pollution Abstracts (DSIR) (Br.) 22:196 (1949).
2. Johannesson, J. K., *Analyst*, 83:153 (1958).
3. Palin, A. T., *Analyst*, 70:203 (1945)
4. ——— *Jour. AWWA* 49:873 (1957),
5. ——— Proc. Soc. for Water Treatment & Examination (Br.) 6:133 (1957).
6. ——— *Baths Service*, (*Br*) 17:21 (1958).
7. ——— *Water & Water Eng.*, (Br.) 62:30 (1958).
8. ——— *Archiv. des Badewessens*, 216, (August 1958).
9. ——— *Gas und Wasserfach*, 1091, (October 1958).
10. ——— "Colorimetric Determination of Chlorine Dioxide in Water," *W & S W* 107:457 (1960).

*Tablets and DPD power available from Messrs. Houseman & Thompson Ltd., Burnham, England or from The Thermidaire Corporation Ltd., Toronto 5.

Illinois Hires Three Sanitary Engineers

Three men have been appointed to the staff of the University of Illinois in the field of sanitary engineering.

Drs. John T. O'Connor and Richard E. Speece were selected as assistant professors and Dr. Ichiya Hayakawa was appointed as a research associate.

O'Connor received his Bachelor of Civil Engineering from The Cooper Union and M.S. from Newark College of Engineering. He received the Doctorate from Johns Hopkins University. He has done research on radioactive metals in river silts and is the author of several papers. O'Connor is a member of Sigma Xi, ASCE, AWWA, WPCF, American Geophysical Union, and the American Chemical Society.

Speece received his Bachelor from Fenn College, M.S. from Yale University, and Ph. D. from M. I. T. His doctoral dissertation was on the biological nutrients and growth in anaerobic digestion. He is a member of Sigma Xi, Tau Beta Pi, and the Yale Engineering Assoc.

Hayakawa was honored with a B.S. in Architectural Engineering by the Takyo Institute of Technology. He received an M.A. from Haverford College in Community Planning and an M.S. in Civil Engineering from Northwestern University. He received his Ph.D. from the University of California for his studies in the field of air pollution and industrial hygiene. He is a member of the Air Pollution Control Assoc.

Uruguay Water Contract Awarded

A contract for a new water treatment plant to provide Montevideo, Uruguay, with 116 million gallons of treated water was recently awarded to Infilco, Inc.

The new plant is the first project to receive U.S. assistance following the Alliance for Progress meeting for economic development in Latin America, held last August.

The $7.5 million project will include a loan from the Export-Import Bank of Washington of $1.9 million to the government of Uruguay for the purchase of filter equipment and controls and storing and feeding equipment for chemicals.

Supplementing this is a loan of approximately $5.5 million by the Inter-American Development Bank for the purchase of materials locally and for fabrication and erection costs and services.

The total project will include canals from the Santa Lucia River, a pumping station and the installation of distribution lines to Montevideo.

Four Infilco "Accelator" treating units will be used in the plant along with 20 gravity filters, control system, valves and interconnecting piping.

This will be the largest high-rate water treatment plant in South America and one of the largest plants of its kind in the world.

Third Mokelumne Aqueduct

The first sections of the longest pipeline of its size in the United States —the Giant "M" Aqueduct, or third Mokelumne Aqueduct—are being placed Northeast of Stockton, California. The cement mortar lined and coated steel pipe, which will supply fresh water from the Pardee Reservoir in the Sierra foothills to the outer fringes of Oakland—a distance of 82 miles, is 87½ in. in diameter. The huge pipe for the first unit of the aqueduct is being manufactured in the new Lockeford, California plant of the Graver Tank & Mfg. Co.

Should Small Water Supplies be Superchlorinated?

Part 1

by E. ROBERT BAUMANN,
Prof. of Civil Engr.,
Iowa Engr. Exper. Sta.,
Iowa State Univ.,
Ames, Iowa

■ MANY TYPES of bacteria, viruses, and other microorganisms exist in water. These may gain entry into a water source from surface drainage, may be flushed into it with sewage, or exist there naturally. Practically the only pathogenic bacteria that can survive in natural water without protection by encasement within particulate matter or other physical protection long enough to transmit disease to man are *Salmonella typhosa*[7], causing typhoid fever; *Vibrio comma*, causing Asiatic cholera; and various species of *Shigella*, such as *shiga, sonne, flexner* and others causing bacillary dysentery. Infectious organisms of the Salmonella group occur frequently in unprotected rural water supplies[1].

Pathogenic bacteria are indigenous to the intestinal tract of warm-blooded hosts, particularly man. Since coliform bacteria are also normally present in the intestinal tract and more readily identified, they are the only specific bacteria for which a search is normally made. The sanitary quality of a water supply is determined by a statistical analysis of results from laboratory tests for coliform. In general, state health departments and public health officials tend to evaluate the sanitary quality of a water chiefly on the presence or absence of the coliform group.

Unfortunately, other microorganisms besides bacteria that are pathogenic to man may be present in water. For example, *Endamoeba histolytica*, a protozoan, is a microorganism which causes amoebic dysentery and may be water-borne. It will survive for long periods of time and remain infectious in water. There is much evidence that the virus of poliomyelitis may also be water-borne. As early as 1912 polio viruses were found in sewage[25]. Epidemics of infectious hepatitis have been traced recently to the drinking of infected water [29, 33, 35]. In 1955, over 50,000 such cases resulted in India from drinking inadequately treated river water contaminated with the virus of infectious hepatitis[16].

The suggestion that water can even be contaminated naturally came from Russia where a water-borne epidemic of tularemia occurred in 1935 among hayfield workers[18]. "Swimmer's itch" and other skin infections designated as *Schistosome dermatitis* affect bathers swimming in infected waters. The causative organism is the cercaria, the free-swimming larval stage of certain parasitic worms.

If the presence or absence of the coliform group of bacteria is to be used as an indicator of the sanitary quality of water, the results of laboratory testing must be associated with the incidence of water-borne diseases in the area served. A satisfactory coliform test only indicates a water to be free of pathogenic microorganisms. In many treated water supplies, the absence of the coliform organisms does not assure that a satisfactory destruction of all pathogenic microorganisms has been effected.

Water is disinfected to kill pathogenic organisms and prevent water-borne diseases. Filtration and other methods of water treatment may remove these organisms but are not substitutes for disinfection. Microorganisms in water may be killed by the addition of chlorine, iodine, or ozone, by exposure to ultraviolet rays, ultrasonics, or by heating.

The work described in this paper is a part of a continuing study of small water supplies and is supported in part by grants from Everpure, Inc. of Chicago, Ill. and from the National Water Purification Foundation.

Chlorine as a Disinfectant

Chlorine is used for disinfection throughout the world. It is commercially available almost everywhere and its use does not require much experience on the part of the operator; a high dose does no human physiological harm; the maintenance of a residual assures continued disinfection; and the residual can be checked by simple tests. Chlorine became commercially available in 1909, but court action and legal decisions were required to establish water chlorination as a process beneficial to the public interest. The correct dosages of chlorine and the required contact periods to effect kills vary from species to species of water-borne microorganisms. These water-borne pathogenic microorganisms may be divided into five different groups:

1. Enteric vegetative bacteria, **e.g. Salmonella and Shigella.**
2. Viruses, **e.g.** hepatitis, polio, and Coxsackie.
3. Spore-forming bacteria, **e.g. Bacillus anthracis.**
4. Intestinal protozoa, **e.g. Endamoeba histolytica.**
5. Worms such as the cercariae of the **Schistosomes.**

Enteric vegetative bacteria are in the group most easily destroyed by chlorine, and the cyst forms of intestinal protozoa and the spore-forming bacteria are most resistant to chlorine. Relatively little is known about viruses and their resistance to chlorine except that their resistance probably falls between that of vegetative bacteria and the cyst forms of intestinal protozoa. The coliform group of organisms has long been considered to be generally more re-

Table 1

Time in minutes required to produce 100 percent kill of the bacteria exposed to free chlorine of different concentrations, pH 7.0, temperature 20 to 25°C.[3]

Free chlorine range, mg/l	Aerogenes	E. coli	Ps. pyocyanea	S. Typhosa	S. Dysenteriae
0.010-0.025	>120	>120	>120	>120	>120
0.026-0.035	>120	>120	5	>120	>120
0.036-0.045	1	120	3	15	120
0.046-0.055	1	15	1	60	3
0.056-0.070	1	90	1	3	3
0.071-0.099	1	1	—	3	3
0.10-0.29	1	3	—	1	—

sistant to destruction by various chemical agents than pathogenic bacteria.

Proper chlorine residuals accompanied by intelligent chlorination control of contact time can eliminate pathogens and food-spoilage organisms from water and can thus provide a solution to most water disinfection problems. Six factors determine the effectiveness of chlorine as a disinfectant, and each factor is important in determining the bactericidal or germicidal effects of chlorine:

1. Type and concentration of chlorine present: Chlorination with "free" chlorine residuals is much more effective than with "combined or chloramine" residuals. With either free or combined chlorine residuals, disinfection becomes more effective with increasing residuals.

2. pH of water: Disinfection of water with chlorine is significantly more effective at low pH values (6.0 to 7.0) than at higher pH values (9.0 to 10.0).

3. Duration of contact of organisms with chlorine: With both free and combined chlorine residuals, effectiveness of disinfection increases with the time of contact.

4. Temperature of water: With both free and combined chlorine residuals, effectiveness of disinfection increases with increases of temperature within the normal water temperature range.

5. Types of organisms present: Different microorganisms react differently under various combinations of factors determining the effectiveness of disinfection with chlorine. In general, we would prefer to have the coliform group of organisms more resistant than pathogens of all groups under all combinations of factors. Unfortunately, this is not the case.

6. Chlorine demand of the water: An increase in the chlorine demand of the water increases the amount of chlorine required to obtain a satisfactory free chlorine residual.

Critical Disinfection Conditions

In operating a water chlorination system for a farm, suburban home, or other small water supply, a system is needed that will operate for long periods without close attention. In other words, the chlorination system must produce safe water under a wide range of conditions. For example, pH water in Iowa farm ponds will usually vary from pH 6.7 to about 8.0. Since farm pond waters are surface waters, any of the five groups of pathogenic microorganisms may be present. Large coliform concentrations and some pathogens may result from the use of the watershed by animals. The temperature of the water will vary from a high between 80 and 90°F in summer to a low of 32°F in winter. As the pond is filled and drained during periods of run-off and subsequent drought, the chlorine demand of the water will vary greatly. Since storage capacity in most small water supply installations is limited to the pressure tank and water lines, the time of contact between microorganism and chlorine will be limited to the time it takes for water to pass from the point of chlorination to the point of usage. This time will usually be measured in seconds. Under these variable conditions, the chlorination system must operate effectively without frequent attention.

To assure destruction of pathogens, the chlorination procedure must adequately control one or two factors to make up for the variation in the others. The pH of the water, the temperature of the water, the chlorine demand of the water, and the types of organisms present cannot be controlled economically. The minimum time of contact may be increased by providing for treated water storage after chlorination, but it is doubtful that this time can economically be made to exceed five to 10 minutes in a pressure system used by the normal small water supply. Only the type and concentration of chlorine residual, therefore, can be controlled to assure adequate disinfection. Optimally, it is desirable to maintain a "free" chlorine residual high enough to destroy all pathogens in a minimum contact period of, for example, seven minutes.

Review of Literature

Experiments have been conducted to determine the relative resistance of various strains of bacteria to chlorine under many conditions. The results reported are not always consistent. Various cultures and strains of pathogens require varying amount of chlorine for disinfection. When hypochlorite solution was used in 1911 as a source of chlorine, at room temperature, the minimum amount of chemical required to kill *E. coli* in the minimum time tested was 1.5 to 3 mg/l of available chlorine. For *S. typhosa*, from 1 to 3 mg/l was required[43]. Early investigators were not aware of the influence of pH on disinfection and the distinction between free and combined chlorine in evaluating the germicidal action of chlorine-bearing disinfectants. Many investigators neglected temperature effect. The minimum chlorine death values for vegetative cells was measured in 1928, but no attempt was made to control the hydrogen-ion concentration of the test samples[39]. In 1936 tap water was used in a study of resistance of coliforms and *S. typhosa* to chlorine and chloramine[14]. Since certain factors then unknown affecting chlorine demand and effectiveness were not controlled, these results cannot be accepted as indicative of the effect of chlorine or chloramine alone.

The data in Table 1 are based on the first published data in which all presently known factors affecting chlorine disinfection were controlled[3]. Tests were made at pH values from 6.5 to 10.7, at water temperatures of 2 to 5°C and 20 to 25°C, and bactericidal efficiency was determined for free chlorine residuals with these general results:

1. At values from pH 6.5 to 7.8, typhosa strains were slightly more resistant than coliform strains to chlorine residuals below 0.1 mg/l.

2. At pH 7.8, coliform strains were more resistant with concentrations of free available chlorine exceeding 0.03 mg/l.

3. At pH 8.5 and above, all strains of E. coli were more resistant to free available chlorine than S. typhosa.

4. At least 0.3 to 0.4 mg/l of free chlorine residual was required at pH 7.0 to kill all bacterial organisms in one minute or less.

In this study of the influence of pH and temperature on the bactericidal properties of chlorine in destroying coliform and other vegetative cells, it was noted that the relative resistance of *E. coli* and *S. typhosa* appeared to shift as the pH of the water changed. This phenomenon was investigated further by making additional experiments using chloramine as the disinfecting agent[2].

Tests conducted at levels from pH 6.5 to 10.5 and at a temperature of 20 to 25°C with species of *E. coli*, *Aerobacter*, and *S. typhosa* indicated that at pH 7.0 and a temperature from 20 to 25°C, 100 percent kill cannot be expected in less than 20 minutes with a chloramine residual of 1.2 mg/l. If all factors are the same, free chlorine is more effective than chloramine as a bactericidal agent. To kill 100 percent of the bacteria, about 25 times more chloramine residual is required than with free chlorine, if pH, contact time and temperature are the same[2].

In later studies, combined chlorine was also found to be much less efficient than free available chlorine as a bactericidal agent[17]. To obtain a 100 percent kill using the same amount of available chloramine as chlorine, the exposure time had to be increased about 100 times.

Test specimens were streptococci and coliforms in another study of the relative effectiveness of free and combined chlorine in disinfection of swimming pool water. This study also indicated[28] that:

1. Free available chlorine is more effective than combined chlorine or chloramine.

2. The minimum chlorine residual of 0.7 mg/l which has been suggested in the past for swimming pools using chloramine treatment is insufficient to produce bactericidal effect.

3. Streptococci bacteria in swimming pools are more resistant to chlorine than coliform bacteria.

The results of tests such as those reported in Table 1 and in similar ones indicate that certain pathogens, such as *S. typhosa* and *S. dysenteriae*, under some conditions common in small water supplies, are more resistant to chlorine destruction than coliforms. This would indicate that in a treated water, the destruction of the coliforms would not necessarily indicate the destruction of all the pathogenic bacteria.

Table 2

Summary of experimental results at 0 C.*

pH	Concentration of FAC†	Percent‡ Survival After Each Time Interval in Minutes					
	mg/l	1	2½	5	10	20	30
6.0	0.10	24.2	10.0	4.8	0.48		
6.0	0.39	5.95	0.75				
6.0	0.80	3.45	3.45				
6.0	1.65	0.37					
7.0	0.04	32.7	21.2	11.8	5.2	2.7	1.1
7.0	0.12	32.0	20.9	6.3	1.3	0.05	
7.0	0.23	25.2	10.1	2.5	0.11		
7.0	0.53	10.3	2.6	0.17			
8.5	0.20	82.6	65.3	50.8	22.9	4.1	1.9
8.5	0.53	68.6	36.1	19.4	3.9	0.18	
8.5	0.59§	70.1	41.6	14.7	2.5	0.102	0.0028
8.5	1.95	46.2	16.3	2.86	0.11		
8.5	5.0	15.3	1.58	0.17			

* Reported by Weidenkopf[42]
† Free available chlorine
‡ The values shown here are based on number of plaques forming from three dilutions of each sample with three plates inoculated from each dilution
§ This run made with 100 times more organisms than others

Recently, the public health significance of virus pathogens in a water supply has become increasingly important. Unfortunately, the resistances of all pathogenic viruses to chlorine have not been evaluated extensively in controlled studies. Early studies were performed in 1931 in France on the inactivation of poliomyelitis virus by chlorine. Although 4 mg/l of chlorine is reported to have destroyed the virus in 24 hours[27], the pH, temperature, and minimum dose were not noted. The quantitative germicidal effect of chlorine on polio virus Type I, has recently been reported[42]. The inactivation of Type I poliomyelitis virus was studied by preparing samples of distilled water containing purified virus suspensions. The samples varied from pH 6.0 to 8.5 at a temperature of 0°C. Chlorine was added, and the percentages of active virus were determined after 1, 2.5, 5, 10, 20, and 30 minutes contact. It was found that a free chlorine concentration of 5.0 mg/l, which is an amount in considerable excess of that usually employed in municipal water supplies, inactivated the virus of poliomyelitis in between 5 and 10 minutes at a temperature of 0°C and pH 8.5 (Table 2).

Hepatitis is another pandemic disease whose control has been seriously handicapped by the lack of evidence concerning its ways of transmission. Hepatitis virus in urine and feces have been reported in Africa[9]. There is no evidence that hepatitis is transmitted by the bites of insects[11]. Definite evidence shows, however, that the common vehicle of transmission of the disease is a contaminated water supply[8,11,29,33,34,35]. The hepatitis virus will pass through a filter and will remain active for several years at 4°C. Because the only method of studying the efficiency of hepatitis disinfection is by using human volunteers, few such studies have been completed[32].

Coxsackie, commonly known as "C" virus, can easily be isolated from feces. Recent experiments[6] show that from seven to 46 times as much free chlorine is required to obtain a comparable kill of "C" virus as was required to kill a suspension of *E. coli*. The results of the tests[6] are complete enough that quantitative interpolations of chlorine residuals required for disinfection under a wide variety of conditions are possible. Coxsackie and bacterial viruses in water cannot be removed completely by common water treatment methods.[4, 5]

This discussion to be continued as Part II in the next issue. In Part II, the author will summarize available data and draw conclusions from these to complete the discussion.

References

To be included in Part II

Operation and Maintenance of Sewage Lagoons*

by C. W. BRINCK, Director
Division of Environmental Sanitation, Montana State Board of Health

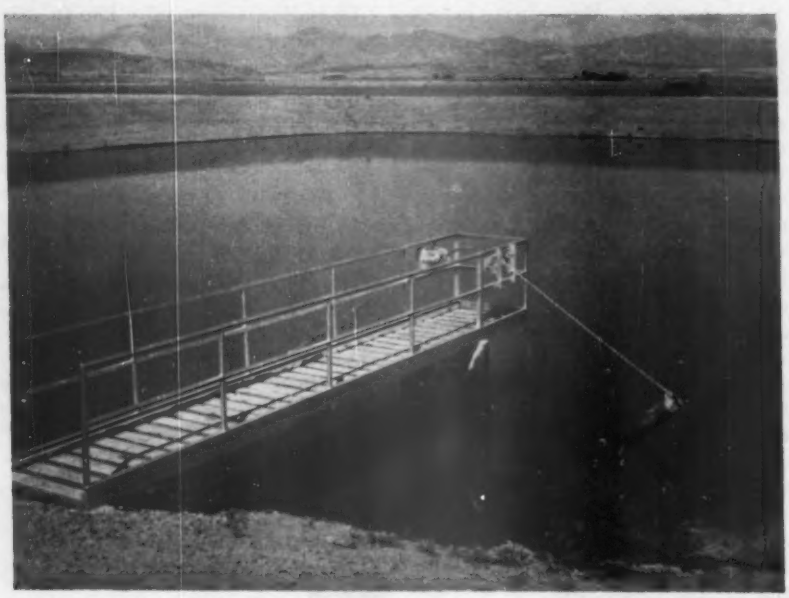
■ RAW SEWAGE stabilization lagoons have revolutionized sewage treatment in Montana. In 1952 upon the urging of the Missouri Basin office of the U.S. Public Health Service and the kind invitation of the State of North Dakota, Montana representatives together with other Missouri Basin states made a trip to study lagoon installations throughout North Dakota. From this beginning, Montana had 44 standard sewage lagoons in operation and 11 under construction on July 1, 1960. Some of these 11 have now been completed and there have been additional ones started since that time.

Lagoons have been successful in Montana since the first one was placed in operation in 1953. We receive such comments as: "most logical and economical way to meet our sewage disposal problem"; "everything about it is excellent and maintenance problems are practically zero"; "we recommend it for any town or city"; "no upkeep or maintenance problem since construction other than riprapping banks"; "very well pleased with operation and cost —no operational problems so far"; "very cheap"; "it is very satisfactory".

These few comments represent the feeling of many of our communities in this state that have sewage lagoons. They also indicate that many of our communities are so cost conscious that they are not maintaining their inexpensive lagoons properly and trouble can be anticipated if proper, but minimal maintenance is not provided.

In August of 1960 I was fortunate to meet in Kansas City with 325 persons interested in sewage lagoons to participate in a symposium on sewage lagoons. Present at this meeting were representatives from 30 states, 8 regions of the Public Health Service, and 8 foreign countries. At this meeting it was brought out that lagoons are working satisfactorily in all states of the United States where they have been tried —from the northern or Canadian border to Mississippi on the south, from California on the Pacific Ocean to Virginia on the Atlantic. A lagoon is being used in Alaska at Fort Yukon inside the Arctic Circle. There are many lagoons in Alberta, Saskatchewan and Manitoba, and lagoons are being used in Melbourne, Australia primarily for new housing developments that cannot connect to the existing sewage treatment plant. Victoria, Australia has two lagoon installations and Queensland is designing lagoons.

*Delivered at Water & Sewage Works Operators School, Bozeman, Montana, November, 1960.



LAGOON TREATING domestic wastes.

Lagoon Location

We ordinarily state that lagoons should be located with the same care as a conventional sewage treatment plant—that is, it is best to have the lagoon downwind from the community and it should be about a quarter of a mile away from the community. This, however, is not always followed. In fact, sewage lagoons are serving some private developments that are within 100 to 200 feet of the development with no adverse effects reported. We think this is rather close.

Two Cells Recommended

One of our problems in Montana is to provide an adequate hydraulic loading for the lagoons. We must design the lagoons for a certain size in order to provide adequate surface area, but in the beginning we find that we do not have enough liquid. If it is not possible to add extra water to the lagoon when it is first being started, we can have trouble with such plant growths as cattails that start in shallow water and then take over. We now try to have the lagoon designed so as to have at least two cells. Then all the sewage can go into the first cell until there is sufficient flow to permit both

cells to operate in parallel.

When there is not too much sewage it is possible to operate a two cell lagoon in series. This allows all of the sewage solids to settle in the first lagoon; the second pond then acts only as a means for clarifying or polishing the effluent since there is not sufficient nutrient material for the algae to grow here. The algae die off in this second pond while the first lagoon will have a very heavy algal growth.

In some places where odor is not a problem there may be an excessively heavy loading of sewage in the first lagoon and then use the second lagoon only to catch the algae and permit it to die off before the effluent drains into a natural water course. This is quite popular in the areas where there is not a great deal of ice formed, but there can be trouble with cloudy weather and not have the algal developments that we like to see. There also can be odor with this type of operation, particularly where there is an excessively heavy loading in the first cell.

The hydraulic loading regulates the depth of liquid in the lagoon. During some Montana winters we may have as much as 2 feet of ice on the lagoon. We suggest that the liquid in the lagoon be drawn down in the fall of the year. The liquid overflow is quite stable because of the excellent algal growth during the summer. In the winter the effluent is not treated to as high a degree as in the summer, because there is not the light available, and with the ice forming on the surface there is no wind action.

Therefore, if we draw down our lagoon to about a 3 feet depth in the fall of the year, which requires flexible controls, the liquid will accumulate in the pond during the winter and raise to a depth of about 5 feet in the spring. In this way there would be no overflow during the winter. The winter effluent that did overflow would have in excess of 75 percent treatment as compared with about 60 percent for the average mechanical plant. About half of the lagoons have no overflow at any time.

Site Preparation and Maintenance

We desire to make the banks of the lagoons just as steep as possible in order to have a minimum amount of shallow water where weeds can grow. Yet, if the banks are too steep the wave action will erode the banks and there will be a gradual leveling out of the banks. We do not want this to happen since it would wash away our roadway that is on top of the banks, making it difficult for the person responsible for the operation to drive around the lagoon to patrol it and be certain that animals are not digging into the lagoon. We suggest that the erosion be controlled primarily by having a good growth of grass on the inside bank.

LAGOON TREATING oil refinery waste.

Weed growths are not helpful but they have taken over at many lagoons. In order to control weeds before the lagoon is built, weedicides can be spread over the bottom of the lagoon. Common ones in use that have been satisfactory are Ureabor made by U. S. Borax, Televar, and Karmex, both made by Dupont. Ureabor is sold by Montana Flour Mills in Montana, and can be distributed at the rate of one pound per 100 square feet using an ordinary seeder since it comes in small pellets. After the lagoon is in operation, and if there is not grass started and the weeds get started, it may be desirable to draw down the lagoon water level and spread one of these weedicides along the bank. Studies by the U. S. Public Health Service indicate that Ureabor does not harm the algal growth in the lagoon.

The primary reason for wanting to keep down the weeds is to prevent the development of mosquitoes. It has been found that wherever there are weeds in a lagoon mosquitoes do grow and breed. The principal mosquito that grows in the lagoon is *Culex tarsalis*. This mosquito spreads and carries the common sleeping sickness, also known as Western *equine encephalitis*. The first reports which we had indicated that mosquitoes did not breed in the lagoons. Apparently the studies were made where there were no weeds growing.

We can control cattails if we can keep at least 26 inches of liquid over the soil. However, if cattails once get started, it is necessary to dig them out, for they can take over a pond. Frequent cutting of the grass and the weeds is necessary. We recommend that the weeds and grass be kept to a 2 to 4 inch height and this can be done by cutting every 3 to 4 weeks.

There must be a good fence around the lagoon in order to prevent stock from wandering into the lagoon. If habitations are nearby, the fence should be child-tight. In Glasgow this summer, a small child found his way to the lagoon and drowned. All the lagoons should have a prominent sign stating that it is a sewage lagoon and there should be no trespassers. One of our problems has been older boys swimming in lagoons.

If there is too large an expanse for the lagoon, there can be problems with waves eroding the banks. Lagoons should not be greater than 40 acres in size. In Montana, the la-

goons are usually about 10 acres in size. If more lagoon area is needed, then the lagoon should be built in multiple cells.

Odor

We have had odors at lagoons reported in 12 of 30 replies to a questionnaire for Montana. Ordinarily the odors are noted in lagoons where there is a high sulfate content in the natural water, and the odors are noted principally in the spring of the year just as the ice is beginning to melt. Ordinarily, the odors do not last more than a few weeks. However, this rotten egg odor or sewage odor can be very disagreeable, particularly if the odor is blowing towards habitations. This odor can be controlled by adding one pound of sodium nitrate for each pound of BOD that is in the lagoon. The nitrate supplies oxygen to the bacteria in place of having the bacteria obtain the oxygen from the sulfate. By preventing the sulfate from breaking down, odors are prevented.

If there are odors, we suggest that there be about 100 pounds of sodium nitrate added for each acre of lagoon each day for 3 days. Follow this with 50 pounds of sodium nitrate for each acre per day for 7 days. Ordinarily this will take care of all of the odor from a lagoon. If not, it may be necessary to add more sodium nitrate.

Careful Design Required

Lagoons are a method of sewage treatment. We now have over 1,000 of them in the Missouri Basin area. The upkeep is very low—much lower than that of a mechanical plant where a man must be on duty 24 hours a day. There is ordinarily no expense for electricity other than pumping costs. Being so inexpensive there is an inclination not to provide any maintenance or operation for the lagoon. This can lead to troubles. A lagoon requires more careful design than the regular mechanical plant where the design engineer can refer to a catalog and decide the kind of unit that should go in. There are many factors that must be considered when the lagoon is designed.

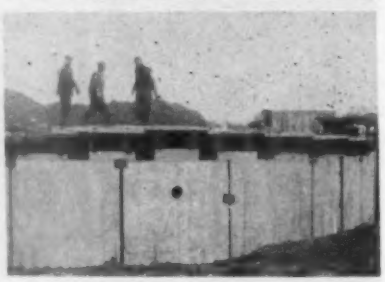
In addition to the lagoons serving a most useful purpose by providing inexpensive sewage treatment, they have assisted in solving the critical problem of conserving our streams by not discharging sewage into them. If the lagoon effluent should be discharged into a stream, it is treated —much higher than most mechanical plants.

First of Its Kind

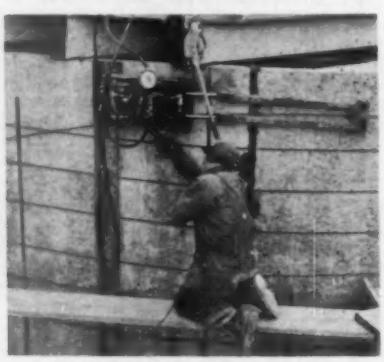
A 190,000-gal. prestressed-concrete water tank at Neoga, Ill., is the first to employ precast wall and roof panels.

Designed and built by the Preload Co., Inc., New York, the tank is 43.5 ft in diameter and has walls 18 ft high. It has 21 wall panels and nine roof slabs.

The wall panels are 6.5 ft thick, formed to the curvature of the tank. Threaded inserts were cast near one end to allow for eye-bolts for lifting. The panels were lowered into position by a crane. The walls were precast by Federal Cement Tile Co., Chicago, and were trucked some 150 miles to the site.



The double-T roof slabs span the entire width of the tank. Slabs were installed in stepped fashion, the highest slab being in the center of the tank. Midwest Prestress Concrete Co., Springfield, Ill., fabricated the slabs and trucked them to the site.



After the roof slabs were in place, wall vertical joints were sealed with dry-packed mortar and prestressing operations were begun. The tank was wrapped tightly with cable. A continuous cable was spiraled around the tank. The cable was tensioned as it was applied.

Plant Engineering and Maintenance Show

A new emphasis on management techniques will feature the next Plant Engineering and Maintenance Show and Conference in Philadelphia, Jan. 22 through 25.

The shift from themes of the past 12 years was due to the new areas of science and engineering which have been developing. Although many of the 43 conferences will still be devoted to preventive maintenance, repairs and inspection, management techniques in the areas of plant engineering and maintenance have been added.

Included will be such topics as cost control, operation-time control, work sampling, personnel relations and similar tools of management. Further information is available from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

Jamaica's Water Director Dies

Cornelius J. Keily, a director of the Jamaica Water Supply Co. since 1909 and formerly its vice-president and general manager, died Oct. 20, 1961, at the age of 84.

Keily had been convalescing staisfactorily from abdominal surgery but succumbed to a heart attack. He was a member of the AWWA, the Jamaica and Queensboro Chambers of Commerce, the Jamaica Club and the Hempstead Golf Club.

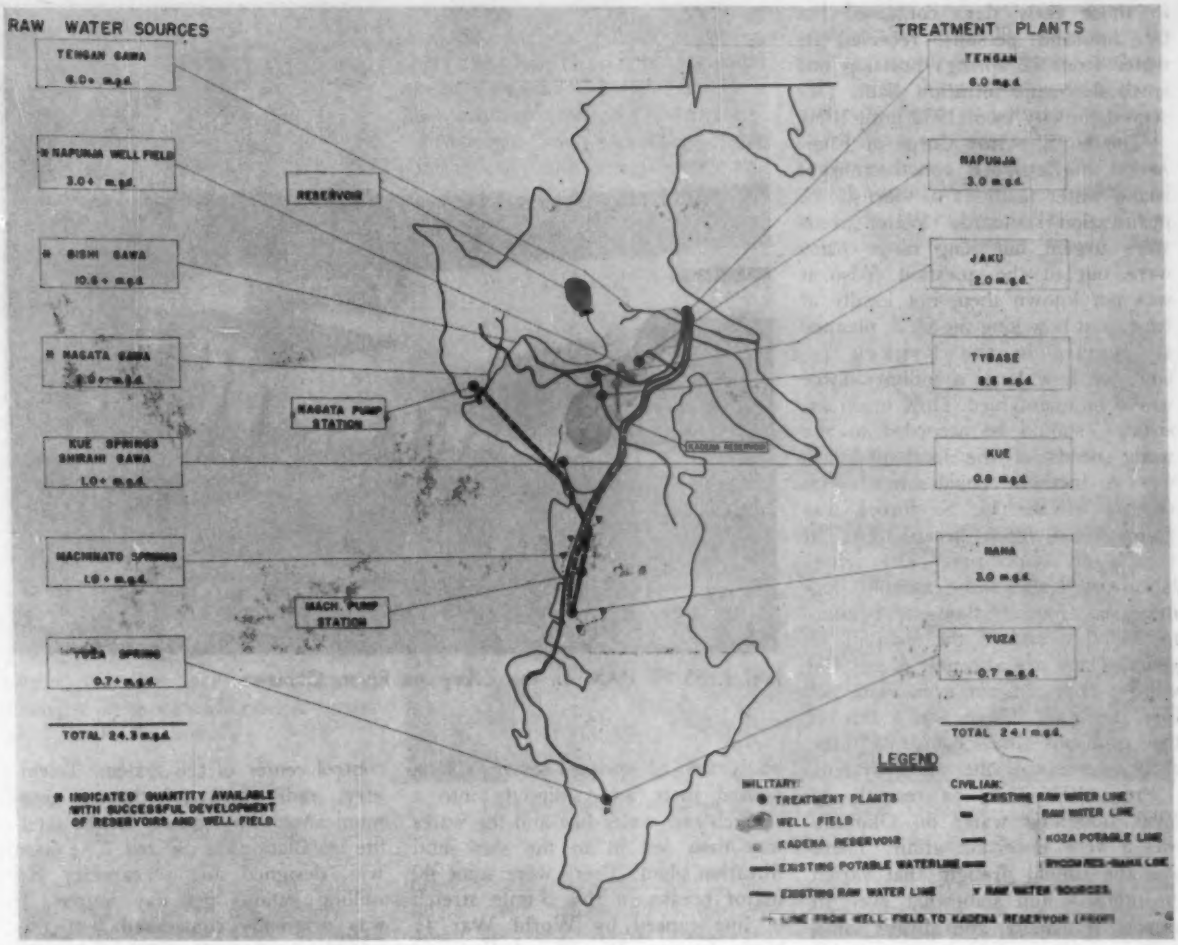


Fig. 1. NEW U.S. WATER System on Okinawa

Water Rationing Relieved by the . . .

U.S. WATER SYSTEM ON OKINAWA

by R. L. LANSCHE
Technical Liaison Officer
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Corps of Engineers

■ Ideally U. S. engineers, back in 1946, would have designed and constructed an efficient and economical water system for the entire island of Okinawa. But things rarely happen in the ideal way and Okinawa's present water system evolved through a slow, painful process of rush emergency construction measures implemented to meet immediate demands for potable water in large quantities. It wasn't until 1950 that a serious approach to an integrated system was undertaken.

In the early days when the U. S. first occupied Okinawa, the main source of water consisted of community wells. These usually served from one to a hundred families. They were constructed of stone, concrete block and mortar. The water was brought up by rope and bucket. Hand pumps, even now, are a rarity and many of these primitive rope and bucket wells are still in use.

The capital city of Naha, which

in those early days contained but 69 thousand persons, received its water from 12 springs utilizing one small slow-sand filtration plant. This served the city from 1932 until 1950.

The U. S. Army Corps of Engineers was assigned construction of island water facilities to meet U. S. purification standards. Water needs were urgent but long range plans were out of the question. Also it was not known then, not locally at least, just how long the U. S. planned to remain in the Ryukyu Islands or how large a military force would be maintained. How much assistance should be accorded to the water needs of the local populace was a further consideration. The coming of the U. S. forces was accompanied by a great influx in the island population. The population of Naha, for example, has increased from 69 thousand persons to 200 thousand in the span of 15 years. There are also new towns and villages that did not even exist before the war. These are a few of the problems that confronted the early planners of the water system.

From 1946 until as recently as 1960, obtaining water on Okinawa was a very uncertain affair. There was the annual drought that varied in intensity and somewhat even in season. It usually, and always for a spell annually, meant hauling water to the heavily populated areas by horse-drawn wagon and trucks.

U. S. Engineers Start Work

The first positive approach to a central water distribution system was delayed until 1950. The water section of Army Command Post, engineer division, was assigned to complete supervision of all water production, island wide. Previous to this order each sub-post supervised the water system in its own area. These independent installations were manned by soldiers and local nationals who, in most cases, lacked the essential technical knowledge to carry out that responsibility. These sub-post units consisted of 12 treatment plants, 2 filter plants, 6 pumping stations and 4 booster stations (See Figure 1).

The first construction priority, in 1950, was the rehabilitation of any of these existing units worth incorporating into a central system. Originally the 12 springs serving Naha poured their water directly into a 12 inch raw water line and the water was then fed in to the slow-sand filtration plant. There were some 40 major breaks in this 3-mile stretch of line caused by World War II battle damage. The 12 inch line was replaced, one old Japanese pumping station was reclaimed and the filtration plant was rebuilt. This effort constituted the total extent to which existing facilities were salvaged. Figure 2 shows the small Naha City water plant, built by U. S. Army Engineers and turned over to the Government of the Ryukyu Islands for operation.

Fig. 3. 55 FT DAM on the Zukeyama River, Okinawa.

The nucleus of the new system is contained in one large plant called "Ty Base" Water Plant (Figure 5). The plant contains the laboratory which tests water samples from all over the island. It is also the major treatment plant and serves as the control center of the system. Telemetry, radio and telephone communication for contact with satellite installations is utilized. The plant was designed for a capacity 8.6 million gallons per day output. It was originally considered that this would supply all anticipated military needs and would furnish one million gallons of water per day to Naha.

Fig. 2. SMALL NAHA CITY, Okinawa, Water plant.

Miscalculation

Unfortunately, this need was underestimated and at present 16 million gallons per day is often distributed. The output never falls below 10 million gallons per day fluctuating with the weather and the season. All facilities are operated on a 24-hour basis. The excess water requirements are presently obtained from continued operation of temporary plants. These plants were scheduled for phase-out when "Ty Base" could put sufficient water on the line.

An increase in military forces has created a chain population reaction which in turn has created the excessive water needs. The military personnel increase has been accompanied by an attendant rise in U. S. civilian workers and increased employment for local nationals. This

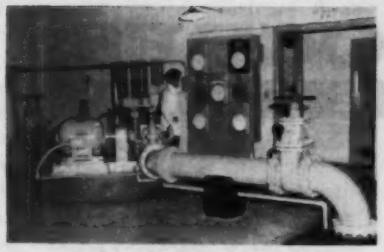

Fig. 4. BOOSTER STATION at Tomari, Okinawa.

situation has created a large migration from outer Ryukyu islands.

Most of the present water supply is derived from the rainfall run-off into surface streams and from deep wells. The island averages more than 80 inches of rainfall per year; however, there is often a shortage of water. Excessive use of water for agriculture, particularly for rice growing, the lack of sufficient water sheds plus the four month annual drought have caused critical water shortages in the past.

New Dam

A recent increase in water collection and storage facilities was created with the construction of Zukeyama Dam shown in Figure 3, which was completed in February of 1961. This 55 foot earth fill dam, when at capacity, backs up some 600 million gallons of water. This supply, through regulated stream flow, can enter the Ty Base plant for treatment and distribution.

Although Army engineers have systematically incorporated most water sources into the island's integrated system, future planning and exploration is a constant program. A present study indicates that a dam on a river, which flows into the ocean at Naha, could furnish that city with 5 million gallons of fresh water per day. Other promising sources, that originally were not suitable for rapid development, such as well fields, bear investigation now.

From the standpoint of potable water it appears that 20 million gallons per day is about all the island can produce. When this amount is regularly required distillation of the surrounding sea water would have to be considered. It is doubtful, however, that with the addition of Zukeyama dam that there will be any serious water shortage on Okinawa for years to come.

Fig. 5. TY BASE Water Plant at Kadena Air Base, Okinawa.

Philadelphia Quartz Co.— 130 Years Old

Just a few years before the start of the Civil War, the Philadelphia Quartz Co. began experimenting with sodium silicate. Until that time, soap and candles had been its only products.

The company made its first recorded sale of sodium silicate 100 years ago on January 21, 1861. The Civil War, which broke out three months later, stimulated the sale of the product for use in soaps, due to the southern embargoes.

By the time the nation celebrated its centennial, the company had added a technical representative who could demonstrate how silicate was used in soap. Calling upon a manufacturer, he produced from his satchel, miniature soap making equipment and proceeded to make a small batch of soap in the buyer's presence.

An array of silicate products was offered, indicating new uses for a versatile chemical. In 1889, growing business in the Mid-West justified the opening of a silicate factory at Anderson, Ind. In 1905 the outdated Philadelphia plant was replaced by a new factory at Chester, Pa. It was decided to concentrate the entire energies of the company on the manufacture and development of silicates.

Today, soluble silicates are used in a wide variety of industries; i.e., soap, detergents, paper, paperboard, textile, refractory cement, oil, rubber, laundry, mining and foundry. They are used for the prevention of corrosion in water lines, for concrete hardening, in metal cleaning, in coagulation of raw and waste waters, in the solidification of foundation soil and catalytic gel manufacture.

The company is presently celebrating its 130th anniversary and its 100th year as a leader in the silicate producing field.

G.E. Studies Sea Water Conversion

General Electric has begun operation of a new laboratory at Burlington, Vt., devoted to developing ways to extract fresh water from the sea.

The laboratory will be used to investigate and develop new technologies for converting salt and brackish water to fresh water and to seek ways to improve present desalting methods.

Sea water for laboratory tests has a saline concentration of about 35,000 ppm. General Electric's thin-film distillation process is capable of demineralizing sea water to less than one ppm, while U.S. public health standards require that impurities do not exceed 500 ppm.

Scope of work presently under way is in the area of obtaining high heat transfer coefficients in evaporation and condensation through the use of thin films of water.

RESEARCH PROGRESS REPORT

A need for better detection methods is shown by this report on .

Determination of Low-Level Radioactivity in Water

by DR. WERNER N. GRUNE
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Atlanta, Georgia

■ EXTENSIVE RESEARCH on the determination of low concentrations of radionuclides in water has lead to at least one major conclusion; an urgent need exists for a reliable, reproducible and rapid method for the detection of gross activity of the order of 10^{-8} μc/ml in water.

Limitations of present equipment make it impossible to detect low-level radioactivity in water without concentrating the radioactive substances. Concentration is accomplished by evaporation, distillation or solvent-extraction. Concentration by ion exchange is also used for analysis of a large number of radionuclides from water samples for mass sampling.

From this research it is expected that additional information on the distribution of radioactivity between filterable and non-filterable matter will be obtained. Based on such information, a simple and reliable method for rapid radioassays would be of immediate and general application in this field.

These studies were to develop a rapid and reproducible method for determining the gross alpha, beta and gamma radioactivity in water. There is presently no instrument capable of measuring activity approaching 10^{-8} μc/ml in water. The studies were, therefore, conducted with concentrated water samples.

Evaporation methods involve loss of short-lived isotopes. It is impractical to count 0.22 disintegration per min for water containing radioactivity of 10^{-7} μc/ml with an instrument registering a background rate of 10 to 20 counts per min. Consequently, it is necessary to determine activity at levels as low as 10^{-8} μc/ml or 10 μμc/l. Measurements of this low order of magnitude are needed to determine the background radioactivity in natural waters and to detect increases in activity before they reach levels which interfere with the use of the water.

From these investigations the following results are expected: a rapid and reliable method for the analysis of gross low-level activity in water; an accurate and simple technique for the separate determination of filterable and non-filterable activities; and a portable apparatus for the separation of filterable and non-filterable activities and for their concentration.

Results Of Experimental Work

Radionuclide Concentration by Ion Exchange Resins

It has been established rather conclusively that radionuclides are removed from solution by ion exchange resins, although little work has been reported on the removal of very low-level mixtures of radionuclides in water.

Most of the naturally occurring radionuclides are fairly well absorbed by ion exchange media. Almost all of these radionuclides or their complexes are tri- or tetra-valent ions. Many of the cations have small ionic radii and are considerably hydrated. The only naturally occurring radionuclides likely to be present in water in measurable amounts are Uranium-238, Thorium-232 and Radium-226 and their disintegration products. These radionuclides are found to be adsorbed quite well by ion exchange resins and both uranium and thorium are quantitatively adsorbed.

From results obtained thus far, it appears that resins of medium cross linkage, high exchange capacity, high stability and 40 to 60 mesh size for optimum flow rate, will best concentrate radionuclides. Good results have been obtained with a polystyrene, sulfonated cation exchanger in the hydrogen form, a highly basic quaternary amine polystyrene anion exchanger in the hydroxyl form.

Reproducibility of Sample Preparation and Accuracy of Counting

In planning the organized collection of laboratory data on studies for the determination of low-level radioactivity in water, and the analysis of the significance of this data,

it was necessary to evaluate these variables: 1) the reproducibility of activity determinations from a single source of radiation; 2) the difference between the activity from two similarly prepared sources of radiation over a period of time; and 3) the reproducibility of sample preparation as determined from a number of samples, prepared and counted on the same day.

From results obtained from these studies it appears that considerable variation exists in the preparation of samples, although the indeterminate errors of radioactivity measurements are a part of the variance of the data. Further improvements of the reproducibility of sample preparation and the accuracy of counting are necessary.

Wet Ashing Method

A method for wet ashing ion exchange resins has been investigated, using a mixture of concentrated perchloric, nitric and sulfuric acids. This method does not require any highly specialized equipment. The prime requisite is the availability of a well ventilated fume hood.

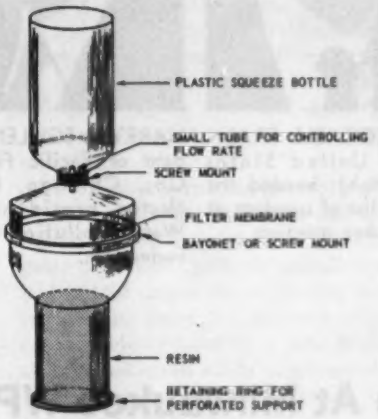
During the ashing procedure, a part of the sulfuric acid is decomposed into sulfur trioxide and water, the sulfur trioxide being driven off with heat. After ashing is completed the substances adsorbed on the resin are contained in a small volume of concentrated sulfuric acid. Additional studies are necessary, however, to further evaluate the reproducibility of the wet ashing method.

Dry Ashing Method

A method of dry ashing ion exchange resins is also under investigation. Several variations of this technique have been employed beyond the direct dry ashing method. These variations include dry ashing with magnesium nitrate, ammonium nitrate and pretreatment with hydrogen peroxide. However, the direct dry ashing method proved to be the most feasible. This method is easy to perform and requires only two basic items of equipment, porcelain evaporating dishes and the muffle furnace. The dry ashing method requires less manipulation and supervision than the wet ashing method.

Comparison of Wet and Dry Ashing Methods

Wet ashing procedures have the following advantages over dry ashing: 1) procedure particularly applicable to small quantities of resin, up to 25 grams; 2) Procedure may be carried out in a liquid medium and at a lower temperature; and procedure is slightly faster. Dry ashing procedure has the following advantages: 1) less subject to error due to fewer liquid transfers; 2) less equipment required; 3) little direct supervision is necessary; and 4) very useful when relatively non-volatile, heavy metals are adsorbed on the resin.



PORTABLE EQUIPMENT for the Separation and Concentration of Low-Level Radioactivity in Water.

Separation of Filterable and Non-Filterable Matter

Millipore membrane filters were used for a preliminary study on the retention of activity by membrane filter. A membrane filter serves the purpose of separating filterable and non-filterable matter from a water sample for a more detailed analysis of gross activity. Results point out that up to three percent of the $\alpha+\beta$ activity was retained by the filter when relatively high uranyl acetate concentrations were employed.

Elution

Although elution is a well established analytical procedure for removing adsorbed ions from ion exchange resins, it is not considered applicable in these studies for several reasons. It requires large volumes of an elutriant. It is probable that a single elutriant would not suffice. It is a more time consuming process.

Future Planning

On the basis of previous studies, the investigations will be intensified with natural and artificial radionuclides to determine the optimum conditions for concentrating them. Much work remains to be done to evaluate the best resins for the different radionuclides and for mixtures of them. Determinations of resins will be based on; flow rate, solids concentration, mesh size, degree of cross-linkage and stability.

Investigations with natural and simulated stream and lake waters will be carried out to determine the amount of resin required to concentrate sufficient radioactivity for counting and to study interference by any minerals in the water.

A portable field apparatus, as shown in the Figure, has been designed to separate filterable from non-filterable matter and pass the filtrate onto the ion exchange column. The non-filterable matter will be retained by a membrane filter. As illustrated in the Figure, a plastic squeeze bottle is mounted above the millipore filter to provide the required pressure for filtration and to standardize the amount of water run through the resin.

Additional research is required to improve and refine both wet and dry ashing methods and to compare them for final choice of method.

Spokane Announces Highlights of '60

Spokane, Wash., sewage treatment plant recently released its 1960 annual report listing Highlights of 1960.

The plant employs 22 men selected from 104 enrollees of a 10 week school. All of the operators have attended the Short School at Washington State University and are certified by the State.

Last year, several improvements were made including coded colors on piping and equipment, a skywalk platform beneath filters, leveling of lawn areas, asphalting of clarifier area, equipment installation, vehicle purchases and expansions planned. Total treatment costs were $194,181.04, for an average of $26.72 per mg treated. A total of 1,070 calls were made by the sewer maintenance division.

RAY E. LAWRENCE, President of the Water Pollution Control Federation and consultant, Black and Veatch, Kansas City Mo., presided at the 34th annual Federation meeting.

THE HONORABLE FRANK E. MOSS, United States Senate (Utah), headed the impressive list of speakers at the Milwaukee meeting.

HARRY E. SCHLENZ, president of Pacific Flush Tank Co., Chicago, Ill., was elected president of the Water Pollution Control Federation.

DR. JACK E. McKEE, professor of engineering in Environmental Health, California Institute of Technology, Pasadena, Calif., was elected vice-president of the WPCF.

Record Attendance At Milwaukee WPCF Conference

■ THE 34TH ANNUAL conference of the Water Pollution Control Federation broke all previous attendance records. Nearly 1800 members and their wives attended the meeting, held in Milwaukee, Wisc. Reports of technical papers have been scheduled for later Water and Sewage Works issues.

New Officers Elected

The Federation, whose membership now exceeds 10,000, named as its president, H. E. Schlenz, head of the Pacific Flush Tank Co., to become the first manufacturer to receive this honor. Also elected was Prof. Jack E. McKee, who, as vice-president, will work with Schlenz in carrying on the work of the Federation during the coming year. McKee is professor of engineering in Environmental Health, California Institute of Technology, Pasadena.

Federation Luncheon

Retiring Federation President Ray E. Lawrence presided at the annual luncheon at which the featured speaker was the Honorable Frank E. Moss, U. S. Senator from Utah. Long an active proponent of water pollution abatement, Senator Moss heads the Senate Public Works Committee and was instrumental in providing important portions of the 1961 amendments to the Water Pollution Control Act and securing passage of this legislation.

Senator Moss reviewed past and present water pollution control activities and provided interesting background on the new legislation. Pointing to 1961 as a possible epochal year in water resource management, he suggested that it may be the historic year when the country finally faced up to its water pollution problems.

He referred to water pollution as a "galloping disease," the diagnosis for which was provided by the National Conference on Water Pollution and by work of the Senate Select Committee on National Water Resources. He believes the Federation, through its members and the entire industry, has provided full information for its treatment and cure. Amendments written into the 1961 legislation take five steps, according to the Senator:

1. Broaden and strengthen the Federal enforcement powers.

2. Provide the basis for a greatly stepped-up program of waste-treatment works construction.

3. Call for an intensified program of research, looking toward more effective methods of pollution control, with special emphasis on regional variations.

4. Establish in law the principle of water quality control as a criterion in planning and building Federal reservoirs.

5. Give the Secretary of Health, Education, and Welfare full responsibility for administration.

Honors Conferred

The Federation conferred honorary memberships on Dr. H. Heukelekian and Dr. George E. Symons during its Milwaukee meeting. Heukelekian is chairman of the Department of Sanitation at Rutgers, the State University, New Brunswick, N. J. Symons is a consultant, Larchmont, N. Y.

Samuel A. Greeley, consulting engineer of the firm of Greeley and Hansen, was honored by the Federation, being named to receive the Charles Alvin Emerson Medal. Federation President Lawrence presented the award and referred to Greeley's "devotion to the highest principles of the sanitary engineering profession and for his exemplary career as a renowned consultant."

CONTINUED ON PAGE 481

Sewage Disposal Plant Separates Sanitary and Industrial Flow

■ TO PROCESS over 6,700,000 gallons of sanitary sewage and industrial waste per day, a new $800,000 sewage disposal plant at Watsonville, Calif., was designed and built to handle the influent through two independent systems. It also replaced an outmoded facility at the site.

This disposal plant, built by a joint venture of Freedom County Sanitation District and the City of Watsonville, has three unique features: one is the 100 percent separation of sanitary and industrial sewage throughout the plant; another is steam injection into the circulating sludge at the digesters; and the third, use of bronze-faced flap gates to control flow.

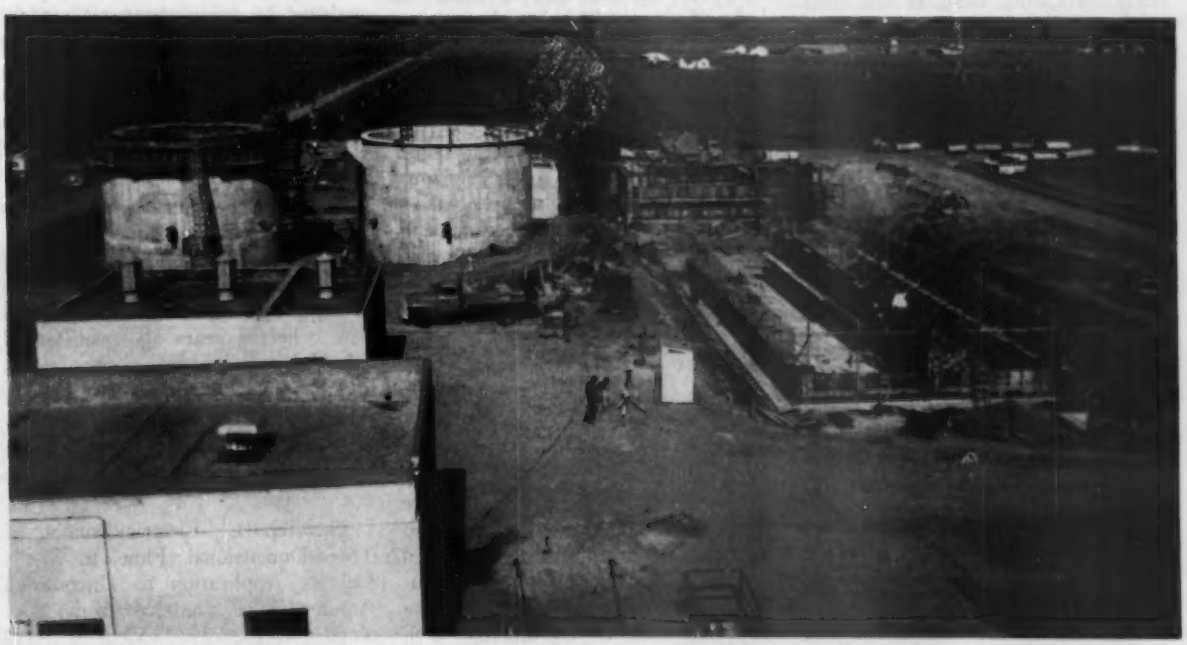
Sanitary flow is chlorinated, passed through comminuting bar screens, preaeration tanks and sedimentation tanks, with the sludge going to two steam-heated digesters in series. It then passes to sludge drying beds, with the effluent flowing into an outlet header.

The industrial influent serving numerous fruit and vegetable processors parallels the sanitary sewage as it passes through the plant. The resulting effluent is picked up by a second outlet header. At this outlet header the industrial effluent can be made to flow into an irrigation line or it can be combined with the sanitary effluent to flow into a single outfall line.

A junction structure at the beach combines both the industrial and the sanitary lines, through a 36 in. flap gate, onto one 3,850 ft outfall line laid on the ocean floor. At this distance from shore the sanitary effluent, already reduced to a safe BOD, and the industrial solids in suspension cannot contaminate the water in swimming areas.

In the plant area, Armco Drainage and Metal Products Co., supplied 24, 30 and 36 in. flap gates with three 24 in. and one 42 in. bronze-faced flap gates; and a 36 in. sluice gate to handle the intricate flow of sewage. Bronze-faced gates at the terminal of the raw sewage lift eliminated the need for installing expensive check valves on the raw sewage pumps. Two bronze-

GATE BEING lowered into sump for installation.

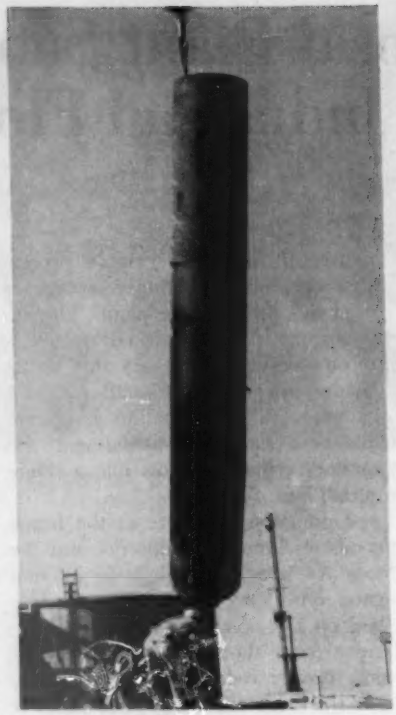


THE TWO DIGESTERS, pump structure, base poured for aeration tanks, sedimentation tanks, with chlorination and present screen plants in foreground. Crane ditches for inlet piping.

faced gates from the former plant were utilized since, on inspection, they were found to be in excellent condition even after years of service. They will be installed in the new lines.

From the original sewage disposal facility the existing chlorination plant was utilized, but existing rotary screens and pumps were abandoned. Also, an emergency 33 in. bypass to nearby Pajaro River was incorporated and in-place piping and electrical conduit remains for possible future use.

The plant was designed by Brown and Caldwell of San Francisco which had Charles C. Hoge II as resident engineer. Royal E. Fowle is the Watsonville City Engineer. The prime contractor was Utah Construction and Engineering Co., San Francisco. Sub-contractors included the Granite Construction Co., of Watsonville, for all earth-work, drainage and paving of access road and parking areas; Crowley Co., of Mountain View for plumbing and mechanical work; and Collins Electrical Co., of Stockton for all electrical work.



WELDED STEEL pipe cement-lined discharge line goes into pump room at Watsonville California new sewage treatment plant.

Ionics, Inc. to Build Water Desalting Plant in Saudi Arabia

Ionics, Inc., reported record first-half sales of its water desalting equipment and research and development services amounting to about $1.2 million.

It was also revealed that pure, fresh water, electrically converted from brackish desert wells, will be supplied soon to the 6,000 inhabitants of the isolated desert community of Dhahran, Saudi Arabia. A salt water conversion plant which will produce 115,000 gpd of good drinking water was recently shipped by the Cambridge, Mass., firm. Dhahran is the headquarters of the Arabian American Oil Company (Aramco), owner of the new plant.

As early as 1954, Aramco began making use of the Ionics "electrodialysis" process in its operation in Saudi Arabia, and some of the first Ionics water desalting plants were installed in Arabia. The new plant for Dhahran will be one of the largest commercial electrodialysis plants in the world. It will replace a distillation system which has been serving the community for a number of years.

Expert Decries Arizona Water Deficit

Arizona's water problems are more acute than anywhere else in the United States according to Dr. Andy McComb, head of the University of Arizona Watershed Management department.

Speaking to the National Watershed Congress in Tucson, Dr. McComb charged that "There is no place in the United States and there are no large areas of the world with more acute water problems than Arizona."

The professor decried the 3,000,000 acre-feet of water per year deficit in the state. This is based on an estimated demand for water of 6,000,000 acre-feet per year, compared to a supply of only 3,000,000 acre-feet per year. "Our main problem," he declared, "is to get enough water to make up the present deficit between present use of water and sustained yield supply."

He warned that sooner or later, mining of ground water must stop. Pointing to studies made in the Sahara Desert, Dr. McComb stated that some of the water there is 40,000 years old, clearly illustrating the length of time it takes to build up ground water reservoirs.

The underground water supply in the basins of central and southern Arizona are estimated to be at least equal to the amount of water in Lake Michigan. This is a large supply and would last for many years were it all available, economic to pump, and there were no salt problems.

Three programs are being studied as possible solutions to the Arizona water problems. They are: 1. getting more water from the oceans and clouds; 2. saving water through better handling and use; and 3. getting more usable water from watersheds.

Ceramic Tile Standards

The standard types, sizes, shapes and grades of ceramic tile for walls and floors are now found in a U.S. standards books.

The standard, Simplified Practice Recommendation R61-61, Ceramic Tile for Floors and Walls, is issued by the U.S. Department of Commerce, and may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at 10 cents a copy.

Electronic Test Analysis

Pumping tests on wells may be analyzed by using electronic models, according to a Geological Survey report.

Pumping tests are made to determine the water-bearing properities of rock formations lying below the land surface.

The report describes the design and construction of an electric analog of flow to wells. The analog was used to compute the properties of water-bearing materials, using test data collected years ago near Grand Island, Nebraska.

The study showed that present methods may lead to inaccurate estimates of the water-bearing properties if the water in the formation is nonartesian.

The report, "Electric Analog of Three-Dimensional Flow to Wells and its Application to Unconfined Aquifers," is available from: Geologic Survey, 1242-G General Services Administration Building, 18th and F Sts., NW., Washington, D. C.

Illinois AWWA Advancement Seminar

■ With Public Relations the topic, the Illinois Section of the American Water Works Association held an Advancement Seminar at the Hotel Orlando in Decatur, the middle of last September.

After the get-acquainted meetings, the seminar opened with a list of speakers directing their attention to the problems of public opinion, press relations and public support.

Your Public Relations Job

J. Edwin Jacobs, director of the Public Relations Division of Buchen Advertising, Inc., Chicago, explained the job of the water utilities official in dealing with the public.

This veteran newspaper and public relations man, and the editor of CIPRA's Community Relations Portfolio, told the 40 members that the biggest job is getting the public on your side.

Ways to Win Your Public

Jim M. Milligan, of Mueller Co., discussed ways in which the men can and should work with civic organizations in the community.

Milligan, who was selected as Decatur's "Young Man of the Year" early in 1961 for his community participation, said that including utility affiliations in any release, and continual contact with the public through talks and films, were the best ways to influence the public.

Stretching Your Printing Budget

Bernard Cullen, chief of graphic arts section of the Chicago Department of Water and Sewers, explained some of the ways in which a printing budget could be expanded.

Of course, Cullen explained, the best way is to stay within the original budget and get the most out of what you have. Cullen has earned a national reputation for the effectiveness of the printed material he has designed working within a limited budget.

Luncheon: Winning Support

Featured speaker of the seminar was Virgil W. Langworthy, editor of Water & Sewage Works, who told members How to Win Support of Public Officials, at the Advancement Luncheon.

Langworthy explained that actually the title was erroneous since each man there had won support when hired for the job and also that each man was a public official.

The editor, who was previously a water works operator and superintendent at Lansing and Adian, Mich., a project engineer for the water and sewage division of Builders Iron Foundry Co., and a research chemist for the Chlorine Institute, set forth several sound principles on which to build and work:

"Seek increased support from everyone; do not relax; do not hit and run; keep your skirts clean;" and what to do and how to do it in press and public relations.

The latter of these he dealt with in detail, telling members just what to do to increase their public support.

Anatomy of a News Release

Sherwood Ross, public relations man of the Department of Water and Sewers of Chicago, and a nationally-published writer on water supply topics, lead a panel on the building of a newspaper story.

The panel staged a practical demonstration on what constitutes a news story, how to gather and write information about the plant in a manner acceptable to editors, and other similar topics.

The discussion continued the entire afternoon and directed these subjects towards practical application in the field.

A report of Research being carried on in England dealing with the . . .

Composition of Sewage and Sewage Effluents - Part 2

by LEO WALTER, Consulting Engr.
and Technical Author
Painswick, Nr. Stroud
Glos., England

■ THE COMPOSITION of sewage under investigation at Stevenage, England, has revealed interesting results. The concentrations of various chemical groups, in solution and in suspension, in fresh sewage are given in Fig. 2c and Table 4. The values in the figure refer to an 8-hour composite sample and those in the table to a 24-hr composite sample. In both cases about 75 percent of the organic carbon in whole sewage and 79 percent in settled sewage were assigned to chemical groups. About half the identified carbon in solution was in the form of carbohydrate; in suspension fats formed the largest group determined. The increased strength of the 8-hr composite samples was due mainly to higher concentrations of carbohydrates and proteins.

Changes in composition which took place when the settled sewage was subjected to aerobic and anaerobic treatments for 16 hr are also shown in Fig. 3. All groups in solution suffered partial removal on aeration, the most marked decrease being that of carbohydrates, both hexoses and pentoses. Anaerobic treatment brought about decreases in soluble carbohydrates equal to those resulting from aeration (80 to 95 percent), but amino acids were less affected. The anaerobic breakdown was not complete in 16 hr, and the concentration of acids, especially volatile acids, rose. The concentration of organic carbon in solution not identified (27 ppm) was not greatly changed by any of the treatments (19 to 29 ppm).

In other experiments the rate of anaerobic breackdown of carbohydrates in solution at 20°C was found to be 3 to 4 ppm per hr during the first 6 hr, while the concentration of soluble acids rose from about 10 to about 20 ppm. Figure 3 also shows that the most marked effect on suspended matter was the large decrease in the concentration of fats on aeration. Small amounts of carbohydrates were built up into suspended solids by both types of treatment but the concentration of protein increased only on aeration.

Table 4

Composition of Stevenage sewage and of the effluent obtained on treatment in a percolating filter.

	Sewage (24-hr composite sample)			Effluent			Removal	
		Settled (BOD = 380 ppm)			Settled (BOD = 12 ppm)			
Constituent	Whole	Soluble	Total	Whole (ppm)	Soluble	Total	by biological filtration	by biological filtration followed by settlement (percent)
Fat - acid	71.0	0	46.1	0.12	0	0.04	99	99
Fat - ester	28.2	0	23.5	0.12	0	0.02	99	99
Protein	31.0	8.0	21.5	2.99	0.99	0.99	86	95
Amino acids	5.0	5.0	5.0	0.06	0.06	0.06	99	99
Carbohydrates	55.0	40.0	46.0	1.63	0.24	0.57	96	99
Soluble acids	21.0	17.0	19.8	1.78	1.65	1.69	91	91
Amides	1.5	0	1.0	(not determined)			—	—
Anionic surface-active agents	14.0	11.0	13.1	1.45	1.40	1.41	89	89
Creatinine	3.5	3.5	3.5	(not determined)			—	—
Amino sugars	1.8	0	1.1	0.38	0	0.07	65	94
Muramic acid	0.2	0	0.1	0.05	0	0.01	50	90
Total — by analysis	311	106	228	26.9	14.0	16.5	88	93
— by addition	232	85	181	8.6	3.6	4.9	—	—
Proportion identified (percent)	75	80	79	32	26	29	—	—

Composition

Volatile acids: Of the acids present in solution in fresh sewage, about half, in terms of acidity, were volatile in steam. The average concentration of volatile acids in four 24-hr composite samples was 14.9 ppm (range 8.5 to 20.1) while the average of five 8-hr composite samples was only 4.5 ppm (range 3.5 to 5.3). This difference is due to genuine differences in composition at the time of sampling and only partly, if at all, to production of acid after sampling. The concentration of volatile acids in Stevenage sewage falls

within the range 2.5 to 20 ppm reported for American sewage[8, 9].

Formic, acetic, propionic, butyric, and valeric acids, or isomers of the last two, were detected in fresh sewage and the large increase in acidity brought about by anaerobic conditions was due to acetic acid and, to a lesser extent, formic acid.

Non-volatile soluble acids: Twelve or more non-volatile acids were detected in solution in fresh sewage by silica-gel chromatography. Six were provisionally identified as glutaric, glycolic, lactic, citric, benzoic and phenyl-lactic acids. A few of the acids were present in sewage at a concentration of 1 ppm but most were present at the 0.1 ppm level or lower.

Higher fatty acids: Reversed-phase chromatography on paper or columns has shown that about two-thirds of the higher fatty acid content of fresh sewage solids consists of palmitic, stearic and oleic, or oleic-type, acids present in roughly equal proportions.

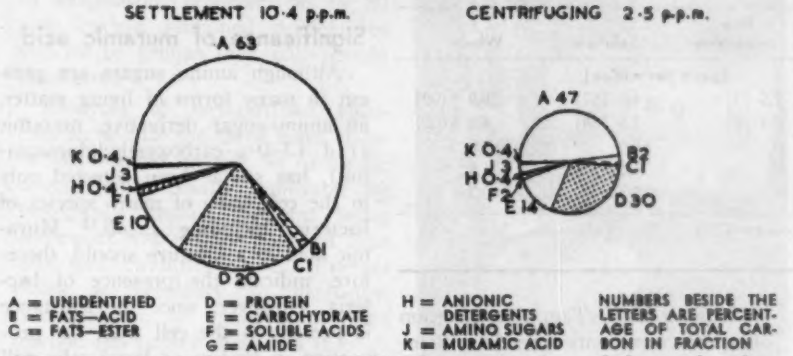
Proteins and amino acids: It was thought that protein and amino-acid values reported here might be low since only 45 to 65 percent of the Kjeldahl nitrogen reacted in the ninhydrin test for amino acids. Confirmation of these values, however, comes from a recent paper[10] from which it may be calculated that 45 to 50 percent of the total nitrogen in various sewage solids and sludges was present as amino acids. These were determined more accurately than in the present work by separating the individual amino acids, some twenty in all, chromatographically before estimation.

Carbohydrates: The main sugars present in solution in fresh sewerage were found by paper chromatography[5] to be glucose, sucrose and lactose, with smaller proportions of galactose, fructose and the pentoses, arabinose and xylose. The hexose/pentose ratio ranged from 10 to 12. Glucose was the main component in hydrolysates of the three types of suspended solids; galactose, arabinose and xylose were also present in all solids. Mannose, ribose and the methyl pentoses, rhamnose and fucose, were present only in some solid fractions. The hexose/pentose ratio in solids was 2.0 to 2.6.

Composition of sewage effluents

The distribution of organic carbon between suspension and solution in whole effluent (Table 5) shows that a larger proportion was present in

Solids obtained from filter effluent in two successive stages [x 20 compared with (a) & (b)]



COMPOSITION OF SUSPENDED SOLIDS as proportions of the total carbon

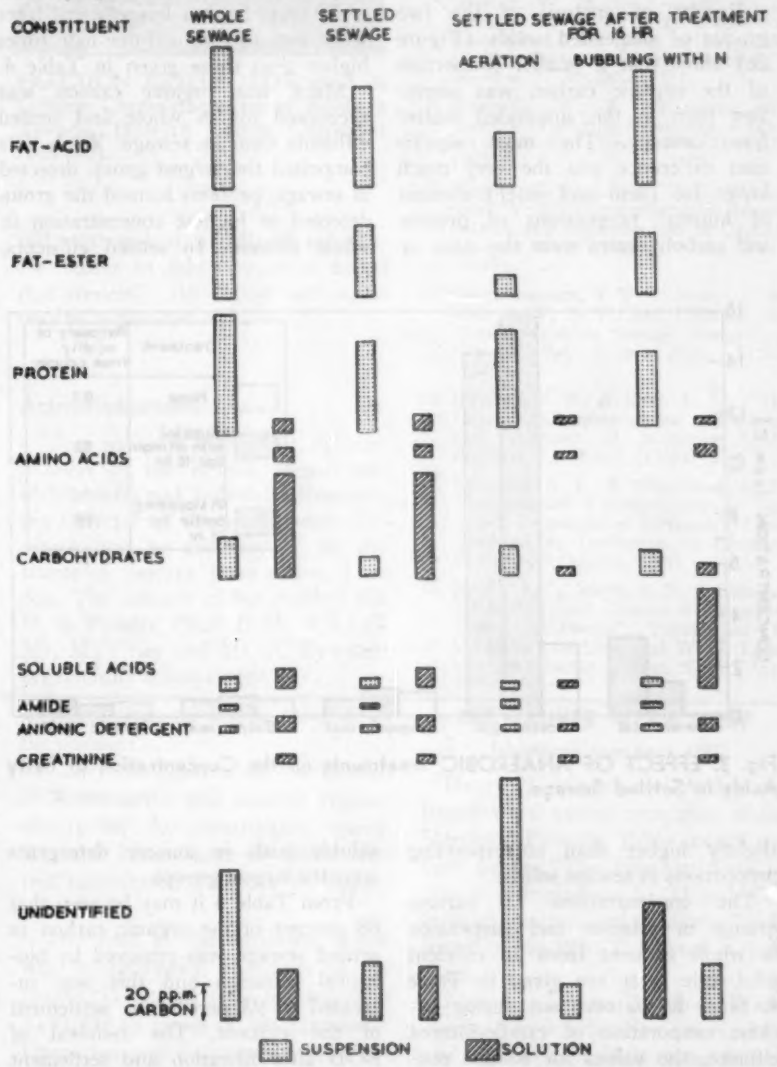


Fig. 2d. COMPOSITION OF WHOLE Sewage and Settled Sewage before and after Aerobic and Anaerobic Treatments. (Results in ppm).

Table 5

Distribution of organic carbon and nitrogen between suspension and solution in effluent from percolating filter treating Stevenage domestic sewage.

Constituent	Coarse suspension	Fine suspension	Solution	Whole
		(parts per million)		
Organic C	10.4 (39)	2.5 (9)	14.0 (52)	26.9 (100)
Total N (Kjeldahl)	1.7 (37)	0.4 (9)	2.5 (54)	4.6 (100)
Oxidized N	0	0	68.0	68.0
Ammonia N	0	0	1.5	1.5
Suspended matter	31.2	8.8	0	40.0

Figures in brackets are percentages of total concentration.

solution and a smaller proportion in fine suspension than in settled sewage.

Results of analysis of the two grades of suspended solids (Figure 2c) show that a smaller proportion of the organic carbon was identified then in the suspended matter from sewage. The most significant difference was the very much lower fat (acid and ester) content of humus; proportions of protein and carbohydrates were the same or slightly higher than corresponding proportions in sewage solids.

The concentrations of various groups in solution and suspension in whole effluent from an efficient pilot-scale filter are given in Table 4. Since losses occurred during cyclone evaporation of candle-filtered effluent, the values for soluble constituents are probably low, especially for volatile acids included under "soluble acids". The concentration of most constituents, soluble and insoluble, in the effluent, having a BOD of 29 ppm, from a less efficient filter were two to two-and-one-half times higher than those given in Table 4.

Much less organic carbon was accounted for in whole and settled effluents than in sewage. While fats comprised the largest group detected in sewage, proteins formed the group detected in highest concentration in whole effluent. In settled effluents, soluble acids in anionic detergents were the largest groups.

From Table 4 it may be seen that 88 percent of the organic carbon in settled sewage was removed by biological filtration and this was increased to 93 percent by settlement of the effluent. The removal of BOD after filtration and settlement was 96 percent. Only proteins, amino sugars and muramic acid were removed to a lesser extent by biological filtration than the total organic carbon. Subsequent settlement brought the percentage removal of these groups to that of the total organic carbon.

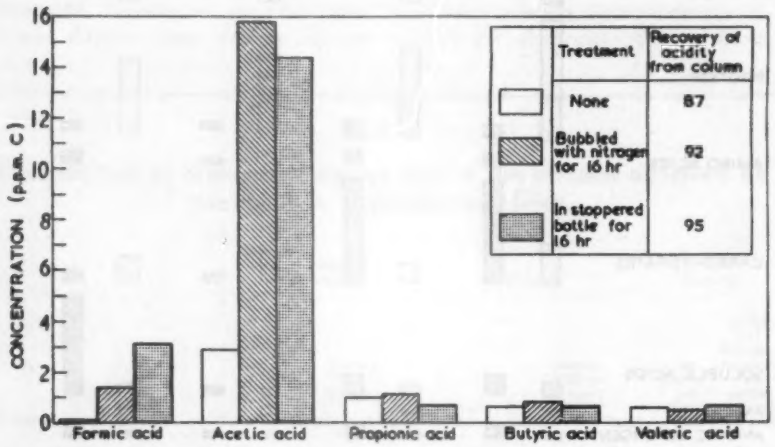


Fig. 3. EFFECT OF ANAEROBIC Treatments on the Concentration of Fatty Acids in Settled Sewage.

Significance of muramic acid

Although amino sugars are present in many forms of living matter, an amino-sugar derivative, muramic acid (3-0-a-carboxyethylglucosamine), has so far been detected only in the cell walls of many species of bacteria, including *E.coli*.[11] Muramic acid in a mixture should, therefore, indicate the presence of bacteria. However, since the substance is present in the cell wall, the proportion in broken or lysed cells will be greater than in whole cells. Thus the proportion of muramic acid in a mixture can be taken only as a rough indication of the proportion of bacteria present.

The proportion of the total organic material, present as amino sugars, in eight samples of sewage solids was 0.60 percent and in seven samples of humus solids 3.4 percent. The proportions of muramic acid in the same samples were 0.06 percent and 0.42 percent, indicating that humus solids probably contained about seven times as much matter of bacterial origin as suspended solids in sewage.

Conclusions

Up to three-quarters of the organic carbon content of crude domestic sewage has been assigned to chemical groups, leaving 70 to 100 ppm unidentified; most of this was in suspension. Sufficient information is now available concerning the composition of sewage for use in theoretical studies of the kinetics of sewage purification, such as those recently discussed by Downing and Wheatland[12].

It is thought unlikely that any major soluble constituent has been overlooked, and it is suggested that the 20 ppm or so organic carbon remaining unidentified is probably made up of small concentrations of a large number of compounds. Other substances have, in fact, been detected in Stevenage sewage; for example, phenols, sterols and uric acid each accounted for about 1 ppm carbon, and aliphatic amines for

about 0.1 ppm. The literature contains references to the presence in very low concentrations of many more compounds, including vitamins, hormones condensed aromatic hydrocarbons, indole and skatole. In suspension, however, 50 to 80 ppm carbon remained unidentified and major groups may still remain undetected.

Analyses of well-purified effluents show that the three main classes of organic matter in domestic sewage were readily removable by biological filtration, proteins being somewhat less readily removed than fats and carbohydrates. Further work is necessary to determine whether the 18 ppm unidentified carbon has passed unaltered through the filter or is made up of substances formed in the filter. There are few indications as to the nature of these unidentified compounds; one suggestion[13] is that about 40 percent of the organic matter in solution in effluent is of high molecular weight, since it is not dialysable.

It is proposed to extend the program of analytical work to include raw and digested sewage sludges. These present a rather different problem, since the organic carbon content is about a hundred times greater than that of settled sewage; about 90 percent of this is in suspension compared with 50 percent in settled sewage.

In applying these results to the study of sewage-treatment processes it must be remembered that the rate of breakdown of a compound, whether by aerobic or anaerobic treatment, depends on its state of organization. It may be present as the free compound, as a polymer, or as part of a plant or bacterial cell. Although it is difficult to classify matter in this way, it is hoped that recently developed techniques may be applicable.

FRACTION COLLECTOR used in Column Chromatography of Acids in Sewage. (British Crown Copyright reserved).

Acknowledgements

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References.

1. Painter, H. A., "Some Characteristics of a Domestic Sewage", *Water & Waste Tr. J.*, **6**:496 (1958).
2. Truesdale, G. A., "Maturing of Percolating Filters", "Observations on the Maturing of Various Media", *J. Inst. Sewage Purif.*, **4**:366 (1960).
3. Wood, T., "A Laboratory Electrodialyser and Desalter", *Biochem. J.*, **62**:611 (1956).
4. Ministry of Housing and Local Government, *"Methods of Chemical Analysis as Applied to Sewage & Sewage Effluents"*, H. M. Stationary Office, London (1956).
5. Painter, H. A., & Viney, M, "Composition of a Domestic Sewage", *J. Biochem. & Microbiol. Tech. & Engng*, **1**:143 (1959).
6. Perkins, H. R., & Rogers, H. J., "The Products of the Partial Acid Hydrolysis of the Mucopeptide from Cell Walls of *Micrococcus lysodeiktious*", *Biochem. J.*, **72**:647 (1959).
7. Crombie, W. M. L., Comber, R., & Boatman, S. G., "The Estimation of Unsaturated Fatty Acids by Reversed-phase Partition Chromatography", *Biochem. J.*, **59**:309 (1955).
8. Rudolfs, W., & Heinemann, B., "Growth Promoting Substances in Sewage and Sludge", *Sewage Wks J.*, **11**:587 (1939).
9. Mueller, H. F., Larson, T. E., & Lennarz, W. J., "Chromatographic Identification and Determination of Organic Acids in Water", *Analyt. Chem.*, **30**:41 (1958).
10. Subrahmanyam, P. V .R., Sastry, C. A., Rao, A. V. S. P., and Pillai, S. C., "Amino Acids in Sewage Sludges", *J Wat. Pullut. Contr. Fed.*, **32**:344 (1960).
11. Strange, R. E., & Kent, L. H., "The Isolation, Characterization and Chemical Synthesis of Muramic Acid", *Biochem. J.*, **71**:333 (1959).
12. Downing, A. L., & Wheatland, A. B., *"Fundamental Considerations in Biological Treatment of Effluents"*, Paper presented to Institution of Chemical Engineers (October 1960).
13. Bunch, R. L., Barth, E. F., & Ettinger, M. B., *"Organic Content of Secondary Sewage Effluents"*, Paper No. 8, Conference on Biological Waste Treatment, Manhattan College, N. Y. (April 1960).

Debris-Control Facilities

A Bureau of Reclamation plan to construct debris-control facilities on the Columbia River under a cooperative cost-sharing agreement was announced by Secretary of the Interior Stewart L. Udall.

The Secretary said that floating debris has been a big problem in areas above the Grand Coulee Dam. The debris damages downstream facilities and creates a hazard to boating and recreation.

The Columbia Basin Inter-Agency Committee, made up of Federal, State and local agencies, created a sub-committee to find a solution to the problem.

Under the agreement, the Bureau of Reclamation will assume responsibility for the construction, operation and maintenance of debris control facilities on Franklin D. Roosevelt Lake.

The cost of the facilities, which will be primarily a system of log booms, is limited to a maximum of $150,000 by terms of the agreement. Operation and maintenance costs are estimated at an average of $50,000 annually.

MILWAUKEE WPCF MEET

(Continued from page 474)

Henry N. Myrick and Arthur W. Busch were named recipients of the Harrison Prescott Eddy award for their paper: "The Selective Stimulation of Respiration in Mixed Cultures of Bacteria and Protozoa," published in the WPCF Journal in July, 1960.

Myrick is a research fellow, Washington University, St. Louis, Mo., and Professor Busch is research associate professor of sanitary engineering, Rice University, Houston, Tex.

Determination of Boron in Sewage Effluents

by REMO NAVONE, Chief, Branch Public Health Lab., State Dept. of Pub. Health Los Angeles, California

■ IF BACTERIOLOGICALLY SAFE, most domestic sewage effluents can be used for agricultural purposes. This utilization can benefit a community by providing a safe and satisfactory disposal of effluents that might otherwise cause stream pollution and at the same time can provide agricultural nutrients for the land.

Sewage effluents contain greater amounts of dissolved material than the original waters and the amounts of boron, chloride, total dissolved solids and sodium ratio, for example, are of importance to agricultural users. In some cases, a sewage effluent may be produced that would have mineral contents greater than the desirable limits for agricultural use. High boron concentrations have caused the greatest concern in citrus irrigation areas and while traces of boron are necessary for plant growth, continual irrigation of plants with a water containing more than 0.5 mg/l boron will ultimately produce some plant injury. Plants, however, vary in their sensitivity to boron. The most sensitive crops are citrus, nuts, and deciduous fruits; semi-tolerant are truck crops, cereals, and cotton. Most tolerant are lettuce, alfalfa, beets, asparagus and date palms.

This paper presents a method for the colorimetric determination of boron in sewage effluents using curcumin[1, 2]. Experimental data obtained will show that concentration and ashing of the sample is not required. The colorimetric determination is performed on one milliliter of the sample.

The value of this curcumin procedure lies in its extreme sensitivity to quantities of boron in the 0.1 to 1.0 microgram range. Data are presented comparing results obtained by the curcumin and carmine procedures.

Apparatus

a. Spectrophotometer or filter photometer operated at 540 mμ with light path of 1-2 cm.

b. Evaporating dishes, platinum, vycor, porcelain or glass, 100 ml capacity.

c. Water bath set at 55 ± 2° C.

Reagents

a. Curcumin-oxalic acid solution: Dissolve 0.040 g of finely ground curcumin (Eastman No. 1179) and 5.0 g oxalic acid in 80 ml 95 percent ethyl alcohol. Add 4.2 ml conc. HCl and make solution up to 100 ml with ethyl alcohol in a 100 ml volumetric flask. This reagent will be stable for several days if stored in the refrigerator.

b. Standard boron solution A: Dissolve 0.5716 g H_3BO_3 in distilled water and dilute to 1,000 ml; 1.00 ml=0.100 mg B. Since H_3BO_3 loses weight on drying at 105° C, a reagent meeting ACS specifications should be used and kept tightly stoppered to prevent absorption of air moisture.

c. Standard boron solution B: Dilute 10 ml of standard boron solution A to 1 liter with distilled water. 1 ml=1 μg boron.

d. Ethyl alcohol, 95 percent.

Curcumin Procedure

a. Preparation of calibration curve: Pipet 0.00 (blank), 0.25, 0.50, 0.75, and 1.00 μg boron into platinum, porcelain, or glass evaporating dishes. Evaporating dishes used must be of the same type, shape, and size. Add 4.0 ml curcumin-oxalic acid reagent and swirl dish gently to thoroughly mix contents. Float dishes on a water bath set at 55 ± 2°C and allow to evaporate to dryness. Remove each dish from bath as soon as contents appear dry and odor of HCl is gone. Allow to cool, add 20.0 ml ethyl alcohol. Stir contents gently with a polyethylene rod to insure complete solution of the red colored product. If solutions are turbid, filter into cuvettes through filter paper (Whatman #30 is satisfactory). Read transmittance of solutions at 540 mμ, setting blank at 100 percent. Plot a reference curve of boron concentration versus transmittance. The calibration curve is linear from 0.00 to 1.00 μg boron. If desired, optical density of the solutions may be read, setting the blank at zero density.

b. Procedure for sewage effluents: For sample containing 0.10 to 1.00 mg/l boron use 1 ml of sample. Samples containing more than 1.00 mg/l boron need an appropriate dilution with boron free distilled water so that 1 ml aliquot contains approximately 0.50 μg boron. Pipet the 1 ml of sample or dilution into a platinum, porcelain, vycor, or glass evaporating dish. Unless the calibration curve is being determined at the same time, prepare a blank and a standard containing a 0.50 μg boron and run it in conjunction with the unknown. Proceed as in (a) above beginning with "Add 4.0 ml curcumin-oxalic acid reagent . . . .". Obtain boron content from calibration curve.

Experimental Data and Discussion

Five 1 ml replicates of a sewage effluent were taken and the boron concentration determined by the curcumin procedure directly without ashing the sample. Results are shown in Table 1.

Table 1

Replicate	Boron mg/l
1	.76
2	.80
3	.80
4	.76
5	.73
Average	.77

To ascertain the recovery of added boron, sufficient standard boron solution was added to a portion of the effluent to increase the boron concentration by 0.40 mg/liter. Five 0.5 ml replicates of this solution were taken and the boron concentration determined by curcumin directly, without ashing. Results are shown in Table 2.

Table 2

Replicate	Boron mg/l
1	1.16
2	1.16
3	1.12
4	1.18
5	1.18
Average	1.16

Comparing results of Tables 1 and 2, it is seen that 0.39 mg of the 0.40 mg added boron was recovered.

The effect of organic matter on the curcumin procedure was next studied. Four 5.0 ml replicates of effluent were placed in platinum crucibles, 0.5 ml of 1N NaOH added and the crucibles placed in a drying oven at 105°C until contents were dry. The residues were then ashed in an electric furnace at 500°C for two hours. After ashing, each residue was taken up in 5.0 ml of 0.5 N HCl and the boron concentration determined by the curcumin procedure as well as the carmine procedures outlined in Standard Methods[2]. A series of boron standards was treated in the same manner for the purpose of constructing a calibration curve. Results are shown in Table 3.

Table 3

Replicate	Boron mg/l (Curcumin)	Boron mg/l (Carmine)
1	.76	.8
2	.74	.1
3	.78	0.0
4	.78	1.4
Average	.77	—

Boron concentration reported by curcumin in Table 3 is essentially the same as in Table 1 indicating organic matter in the effluent did not interfere and that it is not necessary to ash the sample. This constitutes a considerable saving of time. The erratic values obtained by carmine method are studied in subsequent experiments.

Boron recovery under the conditions of drying and ashing were next studied. Sufficient boron standard was added to four replicates of sample so that the boron concentration of each replicate was increased by 0.20 mg/l. These replicates were dried and ashed as indicated above. The residues taken up in 5 ml of 0.5 N HCl and the boron concentration determined by curcumin and carmine. Results are shown in Table 4.

Table 4

Replicate	Boron mg/l (Curcumin)	Boron mg/l (Carmine)
1	.98	.7
2	.98	.8
3	.98	.7
4	.98	1.05
Average	.98	.81

Comparing curcumin values in Table 3 and Table 4, it is seen that 0.21 mg boron was recovered. 0.20 mg/l boron had been added. It is noted that the carmine procedure again gave erratic results. This was now investigated as it was suspected that the erratic results were due to the low value of boron in the replicates taken. Therefore, concentration of the sample was undertaken. Eight 10 ml replicates of effluent were evaporated to dryness with 0.5 ml of 1N NaOH as outlined above. Four of these evaporated samples were dry ashed at 500°C for 2 hours. All eight residues were separately taken up in 5 ml of 0.5 N HCl and the boron concentration measured on a two ml aliquot (equivalent to 4 ml of original sample). Results are shown in Table 5. A series of boron standards was treated in the same manner.

Results in Table 5 indicate that to obtain reasonably consistent values by the carmine method it is necessary to concentrate the sample. Further, these experiments indicate it is not necessary to ash the sewage effluent sample, as essentially the same results were obtained by simply evaporating a sufficient quantity of sample to dryness.

Table 5

Boron by Carmine Method
mg/l

Replicate	Evaporated To Dryness	Replicate	Evaporated to Dryness Plus Ashing
1	.80	5	.90
2	.75	6	.90
3	.83	7	.80
4	.90	8	.75
Average	.82	Average	.84

Summary

A colorimetric procedure using curcumin for the determination of boron in sewage effluents is presented. This procedure is precise and permits the boron concentration to be measured accurately without the need to concentrate or ash the sample. Sensitivity of the curcumin procedure is greater than the carmine procedure and can measure boron concentrations in the 0.1 mg/l to 1.0 mg/l range.

References

1. Navone, R., Louden, L., Goldman, G., and Grady, R. P., *Jour. AWWA*, 50:827 (1958).
2. *Standard Methods for the Examination of Water and Waste Water*, APHA, AWWA, and WPCF, New York. (11th Ed. 1960).

Chicago Decision FOR Fluoridation

The City of Chicago received a favorable ruling in a significant five-year legal battle to uphold its right to fluoridate the public water supply.

Mayer Goldberg, superior court master, recommended the dismissal of an injunction filed by four anti-fluoridationists after hearings said to be "the most exhaustive judicial investigation ever made concerning the fluoridation of public water supply."

The master's decision strongly affirms the health benefits ascribed to fluoridation, rules out possibility of medical injury, and upholds the constitutionality of the practice.

The injunction, originally filed May 7, 1956, was referred to Goldberg on April 24, 1958. In the next two years he held 51 hearings which filled three volumes of transcript comprising 2,930 pages of testimony.

California Section AWWA Holds 42nd Annual Conference

■ THE CALIFORNIA Section, American Water Works Association, held its 42nd Annual Conference at Sacramento, October 24-27, 1961. More than 1300 members, wives, and guests attended technical sessions, exhibits, and social events.

An official visitor from the New York office of AWWA was **John W. Cramer,** AWWA President, who discussed "Improved Water Service". Placing emphasis on adequate salaries, realistic water rates, advanced planning using a five year minimum, and public support as bases to fulfill this obligation.

Ray W. Jones, Sacramento water superintendent described "Sacramento Plans Ahead" for future water source development and plans presently underway to improve treatment plants and storage facilities. Community growth by the year 2030 is expected to approximate one million people.

"Recent Developments in East Coast—New England Water Works Practices" were described by **Dr. Rolf Eliassen,** Professor of Civil Engineering, Stanford University. The discussion included river developments and utilization on which the District of Columbia and its metropolitan area depend. Developments in Philadelphia and Baltimore Water Departments and utilization of streams, including the Schuylkyl and Delaware, were described. Technical problems involving the New York City water supply sources include radioactivity levels, which may require special handling of the water en route to New York's consumers. General features of Boston's water supply, including a description of Quabbin reservoir, were also presented.

CONTROVERSIES OVER WATER RIGHTS

Panel Discussion

Samuel B. Morris, Consulting Engineer, Los Angeles, acted as moderator of this discussion and keynoted the days' activity by describing the background of water use in California. This included the evolution of the riparian and collateral right principles. He emphasized the need for continued emphasis on and execution of the Feather River project to provide water for Southern California. He said that the program will provide benefits not only to the Southern California area but to the entire state.

"State Water Rights" were described by **Burnham Enersen,** San Francisco attorney. State water rights were thought, until recently, to be free of federal jurisdiction except for navigation and flood control. Oregon's Pelton Dam case permitted federal reserve lands to obviate state laws dealing with water rights. He reviewed two other cases—Hawthorne Nevada case which involved wells drilled by a Naval activity and the Fallbrook case in Southern California. He described an urgent need for legislation to return some of the water rights which the states thought they originally had. Such legislation should in effect cancel the decision in the Pelton Dam case.

"The National Interest in Water Resources" was described by **Ramsey Clark,** Asst. Attorney General, Dept. of Justice, Washington, D.C. He discussed in general terms the national and regional water needs versus the available supply which would exist in the United States by 1980. He indicated three areas of effort which were required to correct the problem: provide for storage, minimize pollution, and manufacture fresh water from sea and brackish water. He reviewed the necessity of the federal government to preserve the right of all people in the United States.

"Ground Water Management is Everbody's Business" according to **James H. Krieger,** Attorney of Riverside, California. Two questions are fundamental to the management of ground water basins: Who owns the water? Who owns the interspace, or storage capacity? He stated that people who use ground water must conserve it, and cities, sanitation districts, and industries must adhere to standards which will preserve the natural resource. Importers of water must be able to store it and sellers of water must work with importers to make the most efficient use of the water basins. He called for cooperation in all areas of local control for establishing a master agency with unique powers as the control authority.

"Ground Water Basin Management" was discussed by **Rex Goodcell,** attorney with the Department

CALIFORNIA SECTION AWWA Officers. Seated: John E. Skelton, secretary-treasurer; Henry J. Ongerth, chairman; Hilton H. Harris, vice chairman. Standing: H. C. Medbery, national director; C. M. Brewer, Corona; H. W. Stokes, P. H. McGaughey, George Sopp, and George Burr.

of Water and Power, Los Angeles. He described legislation pertinent to ground water and the proposed bill which details requirements to be met by ground water users. It would provide for record keeping and establish judicating procedures in pertinent cases. He called for an extension of the bill to the entire state and to the support of all interested parties. Activity of the Western states in the legislative areas concerning ground waters as compared to California has been backward in adopting ground water legislation. He emphasized that the public interest requires simplified and extended dedication of ground water interests.

WATER RIGHTS PANEL Discussion Lasted a Full Day. Members were: l. to r., Orville Wright, Rex Goodcell, Samuel B. Morris and George Huberty. Not shown are: Burnham Emerson, Ramsey Clark and James Krieger.

"County-of-Origin Taxation of Water Rights" was discussed by **George Huberty,** attorney of San Andreas. The case of the mountain counties in California, including Mono, Inyo, and Tuolumne, was presented as one in which public agencies from outside the area have utilized water properties at the expense of many counties concerned, primarily in the areas of reducing the tax base from which the counties can derive revenue. He pointed out that continued growth, prosperity, and existence of the mountain counties should have a reasonable tax base, including those of water rights and property owned by outside agencies. In his opinion, the lands and water rights must be placed on the tax roll so that these counties can keep pace with the times and demands of the residents.

"The Water Exporter's Point of View Regarding Taxation of Water Rights" was presented by **Orville I. Wright,** attorney of San Francisco. He reviewed the history of attempts to tax public held property since 1914. He also pointed out that the practice of exempting public-owned water rights from taxation has become an established procedure. Various methods of water rights evaluation were also described.

BUSINESS MANAGEMENT DIVISION

"Safety at the Management Level" was discussed by **Chandler A. Laughlin,** Senior Hydraulic Engineer, Pacific Gas and Electric Company, San Francisco. Functions and interpretations of a safety program can vary at each management level, but functional importance of management at the highest levels was discussed. Participation of all employees is mandatory in a safety program. Management is responsible to see that active participation is achieved. Management's function is to constantly direct, supervise, and control the safety program. Cost figures were reviewed on accident records and how insurance rates are directly affected.

"Application of Tabulating Equipment to Medium Size Utility Billing" was described by **Gerald W. Peasley,** Controller, Dominguez Water Corporation, Long Beach, California. Conversion of the Dominguez Water Corporation's accounting system to modern tabulating equipment was described after a brief historical discussion of the organization of the water company. Suggestions regarding the selection and installation of tabulating equipment were made including carefully laid plans, study of needs, and training for key personnel who will be responsible for operating the equipment.

"Employee Attitudes and What to do With Them" were discussed by **James Harrington, Jr.,** Hackemann and Associates, San Francisco.

PURIFICATION DIVISION

"Behavior and Evaluation of Microstraining for the Lytle Creek Supply" by **Ralph Carter** and **Harvey Ludwig** of Engineering Science, Inc., Oakland, and **H. J. Ongerth** and **J. A. Harmon,** both of the California State Department of Public Health, and **S. H. Woody,** II, San Gabriel Valley Water Company, El Monte, Calif. The paper described the results of one year of testing a 10′ diameter x 10′ long microstrainer, and the characteristics, behavior, and removal of particulates from the Lytle Creek water supply by a microstraining unit. It was concluded that a particulate analysis procedure could be utilized to predict a range of particulate removal. Efficiency for the removal of particulates improved with increased total volume or larger average particulate volume. Microstraining of Lytle Creek water reduced the volume of particulates an average of 64 percent during the 14 sampling periods described. Variations in particulate volume were significantly reduced by the microstraining procedure. Microstraining tends to disperse the debris particles, which consist of an agglomerated mixture of minerals, diatoms and organic debris. It tends to create an equal amount of total particulates in the effluent water as compared to the amount in the untreated water. In the water supply studied, the microstraining process appears to be effective in removing objectional particles, especially those likely to cause consumer complaints.

Jerry Jerauld Receives Nomination of Fuller Award from Walter Weight, r., as National President John W. Cramer Adds Congratulations.

Chlorine demand is also reduced by the process approximately 33 percent and may effect some removal of coliform organisms.

"Manipulative Improvements on the Membrane Filter Technique" were discussed by **J. J. Connors,** Senior Sanitary Chemist, East Bay Municipal Utility District, Oakland, Calif. He described some equipment modifications to the membrane filter technique which has been accepted as an alternative method to the multitube dilution technique incorporated in *Standard Methods for the Analysis of Water and Wastewaters,* 11th edition. Specific items modified as the result of operating experience with membrane filter technique include filter assemblies, consisting of a filter base and a funnel top fabricated from 18-8 stainless steel. Also described were filter unit containers fabricated from stainless steel, which permit removal of the filter base and placement in the stopper of the filter flask without contamination. Arrangements were also altered to increase the ease of performing the membrane filter analysis. Use is made of the E and A medium described in W&SW (June 1961, p. 238) with incubation in large pyrex dishes, which will contain nine of the standard membranes. Modification described assists the laboratory in using the membrane filter technique in a rapid and efficient manner.

"Diatomaceous Earth Filtration" by **G. R. Bell** of Johns-Manville Corporation. The discussion included the necessity for reliability and performance of equipment designed to use diatomaceous earth for water filtration. He also described the use of pre-coat and body feed as essential to the process. Filtration efficiency between ordinary diatomite and material coated with 1 percent aluminum hydrates was compared. The effect of the coating is to extend the filter runs and improve turbidity removal. Also improved is the ability to remove coliform organisms. Massachusetts studies on iron, manganese, and color removal using both vacuum and pressure diatomite filter units were described.

THE ELLIOTT AWARD Went to Robert Diemer, r. Duncan Blackburn made the Presentation.

WATER SUPPLY AND DISTRIBUTION DIVISION

"Water Supply—Domestic Service and Fire Protection" were discussed by **Thomas M. Morgan,** Associate Civil Engineer, Water Resources Division, Dept. of Public Works, Ventura County. His experience indicated that county control of water supply systems installed by land developers is necessary to assure an adequate supply of water for both domestic service and fire protection. Poor water supply systems cannot be used as a basis for reducing land development costs in Ventura county. Procedures now in effect have reduced the fire insurance rates as a result of improving the water supply systems. While older system improvement is desirable, undue financial strain would be placed on many small water companies.

However, many water companies have voluntarily endeavored to prove their system in accordance with the counties' regulations.

"Why Survey Gate Valves?" was a question discussed by **K. L. Wilkerson,** General Superintendent, San Gabriel Valley Water Company, El Monte, and **H. W. Stokes,** Director, Inglewood City Water Department, Inglewood, California. The history of Inglewood and San Gabriel Valley Water Company's previous and present valve inspection and maintenance programs was presented. Operation costs of an improved valve inspection program can be accurately approximated, though intangible benefits also include peace of mind which is realized by evidence that the entire system is in good operating order.

"Gas Engines for Economical Pumping Operation" were described by **J. E. Curtis,** Engineer, Northern Division, Standard Oil Company of California, Taft, California. He pointed out that modern, natural gas engines are reliable, use a form of basic energy that is relatively low in cost, and are easily controlled with respect to operating speed. He urged careful attention to details of selecting and installing engines with a subsequent well-designed preventative maintenance program as necessary to receive dividends in the form of operational savings from gas engine use and operation.

OLD TIMERS AWARDS were presented to Only a Handful of Men although 20 were Named for the Awards.

"Hydrologic Processes of Water, Snow and Ice at High Altitudes" were described **Fred A. Camp,** Civil Engineer, Department of Water and Power, Los Angeles. The resulting effect of high altitude, meteorological phenomena and water and snow were described. Precipitation and evaporation proceeding at different altitudes, often in anomalous situations. Studies indicate that considerable potential water supply is lost through evaporation of snow and water from water shed areas in the Sierra and Nevada range.

"Loss in Water Main Capacity", a committee report by **E. S. Mamrelli,** Principal Water Works Engineer, Dept. of Water and Power, Los Angeles, and **Lee Streicher,** Chief Chemist, Metropolitan water District of Southern California. Steps which can be taken toward eliminating loss in carrying capacity of water

mains include selection of proper materials and use of correct installation practices, plus treatment processes which will reduce or eliminate corrosive tendencies in scale formation, and control the biological growth in mains through the use of adequate chlorination procedures.

New Chairman of the Section is **Henry J. Ongerth,** Supervising Sanitary Engineer, State Department of Public Health, Berkeley. **H. F. Jerauld,** Superintendent, Construction and Operations, Water Department, Pasadena, California, was nominated to receive the Fuller award for the Section, while the Elliot award was presented to **Robert B. Diemer,** retired General Manager of the Metropolitan Water District of Southern California, Los Angeles. The Willing Water Statuette, symbolic of the AWWA Advancement Award was presented to the Los Angeles Department of Water and Power.

Photographs used with this report were furnished through the courtesy of Western City magazine.

Southwest AWWA Golden Year Convention

■ THE FIFTIETH annual convention of the Southwest Section of the American Water Works Association was held in San Antonio, Tex., during the middle of October. This second largest section of the AWWA hosted three days of technical presentations and outstanding entertainment.

Planning for Texas' Water Needs

John J. Vandertulip, chief engineer of the Texas Board of Water Engineers, presented a discussion on planning to supply future municipal and industrial water needs of Texas.

He told of the extreme drought and flood periods seen by Texans and of the drought beginning in 1950 and extending through 1956 which awoke Texans to the seriousness of the problem.

Planning studies indicate that many of the existing reservoirs, and one-half of the 14 reservoirs under construction will not be adequate to meet the projected 1980 requirements, said Vandertulip.

Requirements call for 132 reservoirs having a capacity of 36,300,000 acre-ft and which will provide 17,600,000 acre-ft of flood control storage for a total of 53,900,000 acre-ft. Eighty percent of the water will be from surface-water sources and 20 percent from underground sources.

Master Planning Coordination

Lynn H. Andrews, city manager of San Antonio, said that any master water plan must be active and continuously under change. Its objectives must be clearly stated, approved in policy by the highest authority, and should have no doubts about its goals.

He said services must be improved at the best possible economy and the plan must include means for its attainment.

City Water Board Master Plan

James C. Deal, of the San Antonio City Water Board, showed slides illustrating the evolution of the San Antonio Water Supply from burro drawn wagons, aqueducts and steam-powered pumping from wells, through modern electrically powered stations.

He pointed out that the water comes from Edwards limestone, a formation 1000 ft in the ground. In 1925, the city of 38,000 purchased, for $7 million, an estimated 25-mgd water supply.

New stations, storage tanks, and main extensions were constructed and the old wells and stations were abandoned. Telemetering and centralized controls were added. At present a search is being carried out for added water supplies.

Operations Control Center

W. E. Nusbaum, of Black & Veatch consulting engineers, Kansas City, Mo., described the operations control facilities for the San Antonio water system.

After a study, the city hired experienced operators and provided training for instrument men. The reason: there were 250 miles of lines which cost $250,000, not including the buildings, being used in the 200 sq mi of the area. Improved were system performance and reliability.

In the next few years, several other items were expected to be completed in stages to serve the area: wells, tanks, booster stations, presure control, motor speeds and valve positions are to be controlled from a central location.

Recording of flow and pressure is also being provided for outlying stations, tanks and other monitoring sites. The entire center will be operated by a six man staff.

Pumping Equipment

Phil B. Kosub, San Antonio Machine & Supply Co., said that good maintenance includes: recording of pumping equipment data, serial number, size, curves, and air line lengths. Also one should stock an inventory of equipment repair parts, such as wearing rings, stuffing box seals, shaft bearings, and flex couplings. Starting equipment should be inspected and cleaned at regular intervals.

Selection of equipment should depend upon future needs. Modern equipment is the best, but new developments must be planned for and taken into consideration.

Corrosion Problems

Ben M. Petitt, Jr., director of engineering, City Water Board, San Antonio, answered the question, "Is corrosion a problem?"

He said, in the first place, that corrosion is a problem in the San Antonio water system. He suggested each operator at the meeting should determine for himself whether it was a problem.

Petitt cited the breaking of mains in San Antonio and mentioned that some systems there depreciated 2 percent per year. It will cost the city $1.2 million next year to replace parts of the system, which is the city's main maintenance task.

Well casings, he pointed out, can corrode outside as well as from the inside out. Their stations have steel piping. As for the mains, some soils

contribute to external corrosion where resistivity is low. Tanks are also a weak point for corrosion.

Living with Corrosion

Robert Fitzgerald, from the Electro-Rustproofing Co. in Dallas, answered another question, "Must we live with corrosion?".

He said that the cost of corrosion control is economically justifiable. It is important to consider downtime and replacement costs and to check with experienced corrosion engineers in the course of studying corrosion problems.

He also told of the new alloys for galvanic anodes, such as mg and zn; impressed current anodes; potential profile tests; and an automatic potential control system where variation in electrolytic activity occurs.

Long Term Financing Panel

E. S. Emerson, municipal finance consultant, San Antonio, led a panel on long-term financing and department management.

He reviewed the need for knowing about all sources of funds and means for financing long-term planned improvements. The means he mentioned included: general obligation bonds, revenue bonds and special forms of revenue bonds. He said the borrower should survey resources, income, and debt structures.

Clarence E. Crowe, an attorney from Dallas, discussed the legal aspects of financing. Long-range water plans must include long-range sewer plans, he said. The public entity is limited in its power to the authority given to it by a legislative body.

He said that the availability of the source of supply may have an adverse impact on borrowing availability. This might indicate the desirability of joining neighboring communities in a common effort to solve water supply problems.

W. E. Tinsley, executive director, Municipal Advisory Council of Texas, said that in Texas, the multiplicity of types of water agencies complicated the financing picture, though methods of securing funds remain through the three conventional means:

1. Water works debt administration for outstanding bonds. The accepted range is 1.5 times the income times the outstanding obligations payment rate.
2. Accounting systems must separate capital expenditures from the operating expenses.
3. Auditing should be done by outside firms capable of preparing water works reports.

J. R. Singleton, finance officer, Housing & Home Finance Agency, Fort Worth, discussed urban redevelopment legislation enacted in May 1961.

The act was intended to alleviate unemployment problems in areas of the country. The HHFA issued grants, including funds for water supply, in areas so defined. Loans also can be made where funds cannot otherwise be obtained at reasonable interest rates, provided assurance can be given that funds can be repaid. The population limit was set for towns below 50,000. The payment period is 40 years.

Singleton also described the "advances for planning" program which makes funds available to larger communities.

Are You Organizing?

Harvey A. Sartorius, management consultant, Los Angeles, asked, "Are you organizing and managing your water utilities?"

He described the attitude of the public toward the price of water. He explained three types of organizations: successful operation, too much organization, and too little organization.

Water enterprises, he said, have often outgrown their managers. He suggested the glamourizing of water business on a slow, sure basis. He outlined the skeleton of complete organization from conception to execution, or performance.

The Challenge

Dr. Elbert DeCoursey, director of Southwest Foundation for Research and Education, San Antonio, explained the challenge for executive health.

He described the effect of fat on arteriosclerosis, which may be reversable and preventable by cutting down on saturated fat ingestion.

He advised the executive to reduce his weight, submit to regular physical examinations, to avoid deadlines, to work in comfort, and to exercise reasonably.

What is a Manager?

J. M. Costelly, district supervisor, Management Services Division, Ernst & Ernst, St. Louis, said that managing is a profession with its peculiar skills and abilities. He said that managerial success will be judged in the future by results rather than methods. A manager challenges manpower and develops more effective people.

Personnel Administration Panel

Clyde McCollough, personnel director, City of San Antonio, discussed wages and salary administration and the finer aspects of personnel assignment. The job description system used by San Antonio was described, along with salary structure and assignment of wage classifications.

Mary Frances Boothe, personnel manager, City Public Service Board, San Antonio, said there were 2,100 employees in the departments of gas and electricity in San Antonio.

Personnel development, she said, is an individual matter. She outlined training for college students to relieve summer vacation employees and those absent to fulfill military requirements. She said these students often return after graduation as regular employees.

The Board also participates in college student interview programs during the senior year to augment needs for additional employees. The training program continues and employees subsequently transfer throughout the organization.

How's Your Image?

Stephen J. Matthews, executive director, League of Texas Municipalities, Austin, warned managers to keep their image in focus. One attribute of a good administrator is that he works constantly to strengthen his organization and staff. His aim is also to protect the public interest and investment and raise the prestige of the profession.

Water Quality

In a panel on water quality, **Joe B. Winston,** consulting engineer, Texas State Board of Health, reviewed the progress toward improved water quality and pollution abatement programs.

He pointed out that the new Texas Water Pollution Control law improves previous means available to preserve water quality throughout the state.

Frank Taylor, director of water services, Oklahoma City Water Department, described water quality from the purveyor's standpoint—from source to consumer. He encouraged purveyors to observe the new USPHS water quality standards.

The price of a quality product, he said, may be eligible for increase when costs of desalting are considered.

He pointed out that herbicide used in weed killers used by farmers were contaminants which could become serious if the use was not carefully controlled at the source. He called for national and state legislation for control, and encouraged more research to determine the potential impact of various compounds on water quality.

Taylor also indicated possible future need for a double distribution system to provide different quality of water for different uses. He discussed the impact of viruses, the reduction of treatment plant costs, budgeting, funds for research, the means to remove certain substances from water, and data reporting.

Malcolm Hope, chief of General Engineering Program, Division of Environmental and Food Protection, USPHS, described the problem from the standpoint of the USPHS. He said water quality involves the use of USPHS Standards as a legal document.

Hope does not believe all problems of health with respect to purity of water supply have been solved. He deplored the lack of national plumbing codes and absence of certification programs throughout the country. He also discused the mandatory minimums of radioactivity set by the new standards (AEC):

10 $\mu\mu$c/1 for strontium^{-90}
3 $\mu\mu$c/1 for radium

Federal Radiation Council has established a range of limits for radioactivity in water supplies and food supplies.

Disaster Water Problems

Col. F. H. Whitley, Medical Field Service School, Brooks Army Medical Center, San Antonio, described some of the possible immediate effects of a one megaton nuclear weapon. These include radiation burns and resultant immobilization of key personnel, power interruption, some loss of stored water, treatment and service structures.

Problems presented by fallout were illustrated by using slides based on predicted fallout patterns.

A standard for emergency use is needed, but these are exposures which may be considered maximum for beta and gamma activities:

.09 μ/cc for 10 days
.03 μ/cc for 30 days
.0003 μ/cc for indefinite period

Sensitive equipment and low radioactivity areas are necessary to permit accurate sample analysis. OCD technical bulletin 11-9 contains procedures for determining emergency and other radiation levels.

The following procedures may be considered reliable to the extent shown in removing water-borne radioactivity:

Coagulation, sedimentation and filtration	—50-85 percent
Distillation	—99 percent plus
Ion Exchange	—99 percent plus
Home softeners	—50-90 percent
Boiling and chemical disinfection	—0

Dilution, decay and absorption make water suitable for emergency use after a few days. Monitoring of treated water is necessary to determine whether water can be used safely following contamination by radioactive fallout.

Utilities Legal Problems

Robert Sawtelle, attorney for the City Water Board, San Antonio, described the legal structure of the San Antonio Water Board. He also gave examples of types of litigation, including property and personal damage claims, rate cases, and service extension cases with which the Board has dealt.

Section Awards

Nominated to receive the Section's Fuller Award was **Elwood J. Umbenhauer,** director of El Paso water utilities, while an AWWA life membership was confered on **John P. Smouse,** Dallas, regional construction program director, USPHS. The Community Relations Award was won by the Temple water and sewer department.

Memorial Scholarship Fund Awards were presented to **Judith Ann Jackson, Eugene H. Lowe, III, Lu Ann Moehlman, and Henry J. Graeser, III.**

WPCF 34th Annual Meeting
Water Pollution Round-Up

■ "What We Know About Wastes and Pollution" was described by **Dr. Gordon M. Fair,** Abbott and James Lawrence Professor and Professor of Sanitary Engineering, Harvard University, Cambridge, Mass. In the hundred years or so since the introduction of water-carriage of sewage, much has been learned, but insufficient to keep pace with the needs which have developed. We shall have to give clear and more effective consideration to the kinetic aspects of pollution and the ecological responses of varying bodies of water to imposed pollutional loads. Standard methods of analysis and the establishment of water quality criteria have been developed, but remain inflexible in a period of swift scientific progress.

"What We Need to Know About Wastes and Pollution" was discussed by **Thomas Powers,** Manager, Waste Control and Waste Utilization, Dow Chemical Co., Midland, Michigan. Industrial and municipal water wastes undergo constant change and the pollutors, those concerned with handling the wastes, need to know what effects the wastes have on receiving water usefulness. Restricted water usefulness is pollution. The pollutor presently knows no more about his waste than demanded by control agencies. Pollutional characteristics of effluents should be determined to the extent of effects such as odor, fish "taste", fish toxicity, irrigated plant toxicity, and water treatment process interferences. More should also be learned about the dissolved inorganic and organic matter. Needed is a program of data

gathering designed to give knowledge and to guide the planning for present and future needs.

"Getting Needed Information about Wastes and Pollution" was discussed by **Sidney A. Berkowitz,** Assistant Director, Bureau of Sanitary Engineering, Florida State Board of Health, Jacksonville, Florida. Getting answers to questions about wastes and pollution involves a re-orientation of existing activities. Present programs in research and development are not necessarily co-ordinated with solving problems of control activities. A cooperative approach is needed, particularly in applied research of processes, products and equipment. Utilization of technical data presents a problem because of personnel and time limitations.

Existing education, research, industry and regulatory or control agency activities should be brought into a unified organization. It has been recommended that the PHS act as a clearing house for all technical information in the water quality or pollution control field. A working advisory committee was proposed which would be representative of all facets of the wastes and pollution problem. They would receive all requests for needed information, as well as recommendations for research and development. This committee with the PHS would review research activities and suggest development needs to industry. It would also advise on manpower requirements and tie together loose ends to assure a concerted, progressive program.

GUEST SPEAKER, John G. Strange, president of the Institute of Paper Chemistry, gave members A Rational Approach to Water Utilization at the Industry Day Luncheon.

SYSTEM DESIGN

"Design of Hamilton, Ontario, Sewer System and Sewage Treatment Works" was described by **Donald B. Redfern,** Partner, Proctor and Redfern, Toronto, Ontario. Design requirements were presented for trunk, storm, and sanitary sewers for action required to serve a population of approximately 500,000. Also discussed were the considerations involved in site selection for a sewage treatment plant designed to handle ultimately 120 Imperial mgd. Specific points of interest in the 100-acre sewage treatment plant site are a circular pumping station, 80 feet deep, which receives sewage from two tunnel interceptor sewers. The chlorine facilities are located about 4000 feet from the main plant. Scheduled for start-up in late 1962, the system cost $12,000,000 or $25 per equivalent capita.

"Planning, Development, and Administration of Intercommunity Sewerage and Sewage Treatment Systems in a Metropolitan Complex" were described by **George R. Bingham,** Director, Wayne County Department of Public Works and **R. J. Alexander,** Director, Oakland County Department of Public Works. In discussing the Wayne County, Michigan, situation, it was noted that the metropolitan area in Wayne County, except for the cities of Detroit and Dearborn and several other "core" communities are served by the Wayne County Metropolitan Sewerage and Sewage Disposal System. Existing system improvements, based on a master plan, have been largely accomplished, but the legislative, political and administrative work necessary to bring the project to the construction phase is still being carried out.

In Oakland County, according to Mr. Alexander, it has not been practical or financially feasible for each municipality to provide sewage disposal service within its own municipal boundaries. The need for such service exists, but the solution is area-wide because of topography, terrain and availability of streams to receive treatment plant effluents. The problem has been solved in approximately 122 square miles of the county and planning is proceeding for solutions in the remaining area. The solution is the construction of a county sewer system, financed by the participating municipalities contracting for flowage rights and treatment with Detroit. Thirteen million dollars worth of county general obligation bonds have been sold in the past 3 years for the construction of interceptors to serve the county.

"Large Sewer System Design" was described in a paper written by **Gerry A. Horstkotte, Jr.,** District Manager-Engineer, Central Contra Costa Sanitary District, Walnut Creek, California. The paper related experience in a rural area which had no sewer system in 1947 and now is involved in completion of a second major trunk sewer, treatment plant and outfall. There are over $25,000,000 in public facilities under its jurisdiction.

THE GREAT LAKES RESOURCES

"Physiography of the Lakes" was described by **Norman Billings,** Chief, Hydrology Division, Michigan Water Resources Commission, Lansing, Michigan. The Great Lakes area lies across the southern margin of the Canadian shield—a large worn-down land mass of very old and hard rock. Lake Superior occupies a depression in the shield itself and the other Great Lakes are situated in erosional valleys in the sedimentary rock formations to the south. Recent geological glaciation blanketed much of the area with thick, pervious sediments and created the characteristic lake-studded terrain. Future major waste disposal problems will be created because of heavy navigation demands and continued exploitation of the resources in the area. The Great Lakes total 95,000 square miles of surface area and contain about 5,000 cubic miles of water. This is maintained by rainfall on the lake surfaces and run-off from the land areas.

"Water Uses" described by **Dr. G. A. Rohlich,** Director of the Hydraulic and Sanitary Laboratory, College of Engineering, University of Wisconsin, Madison. The Great Lakes water is used for varied and extensive purposes. About 15% of the U. S. population resides in the area and participates in a diverse economy. Examples of the value of various enterprises in connection with

the Great Lakes were provided including commercial fishing, which in 1959 totalled approximately $104,000,000 of which the U. S. portion was valued at $6.9 million. Electric power required some 11.5 mgd withdrawn per day in the Great Lakes area, of which 5 mgd is estimated to be lost in steam generation. Approximately 325 mgd are used for irrigation, while municipal water and waste uses total 2683 mgd. Predictions of future use of water in the area were avoided in this discussion.

"Current and Future Problems and the Needs to Be Served" were discussed by **Dr. A. E. Berry,** General Manager, Ontario Water Resources Commission, Toronto. A large part of the Great Lakes are used as a boundary between two countries, both of which make extensive use of the water. Problems arisen in the past recognize the importance of the water-way and the use which can be made of it. Problems encountered include lake level changes and resulting effects on navigation, erosion, property damage, and other factors. Some of the problems are industrial expansion, population growth, together with power development and navigation. These have resulted in surveys by the International Joint Commission and by agencies on both sides of the boundary. Progress has been made, and continued effort will be necessary in order to keep this pollution under control. Recreation is an important use of the waters, in addition to oil well drilling, nuclear energy waste, and industrial and domestic wastes disposal.

In addition to recognition of existing problems to care for future needs, there is a need for energetic and continuous action against disposal problems of all types, and for active study of physical properties of the lake, including water movements, currents, and procedures followed on both sides of the boundary.

"Significant Aspects of the Great Lakes-Illinois River Basins Project" were presented by **H. W. Poston,** Regional Program Director, Water Supply and Pollution Control, U. S. Public Health Service, Chicago, Illinois, and **W. Q. Kehr,** Project Director, Great Lakes-Illinois River Basins Project, U. S. Public Health Service, Chicago, Illinois. This project is the largest and one of the first comprehensive water quality management studies to be undertaken by the USPHS. The purpose of the study is to procure data relative to water quality in the Illinois waterway. The Justice Department will use the data in connection with hearings relative to Great Lakes Water Diversion from Lake Michigan by the Metropolitan Sanitary District of Greater Chicago. Many unusual features are included in the project, among which are a study of the currents in Lake Michigan, telemeter instrumentation, and a proposal to erect a rotating model of the Lake to study effect of earth rotation on mass water movements. Infra-red scanners are also being used to detect unknown sources of pollution. The study will require six years to complete and involves the expenditure of an estimated $12,000,000.

SENATOR FRANK E. MOSS (Utah) spoke for clean water at the Federation Luncheon. He is shown talking with Dr. Jack E. McKee, vice-president WPCF (left), and Harry Schlenz, president of Pacific Flush Tank Co., and new president, WPCF.

SLUDGE, RESEARCH NEEDS, AND COLLECTION

"New Developments in the Zimmermann Process" by **F. J. Zimmermann,** President; and **Neal Seegert,** Vice-President, Zimpro Division of Sterling Drug Company, Rothschild, Wisconsin. Design data were presented on a new, low-cost Zimmermann Process unit of an intermittent, or discontinuous, type for small communities. The oxidation-reaction in a Zimmermann Process unit is a function of time and temperature (and pressure). The new discontinuous unit is designed to operate on a twenty-hour cycle at 500-600 psig and achieve end product results comparable to those achieved by the continuous units. Insoluble organic matter reductions of the order of 80% to 90% are achieved, while the mechanical equipment has been greatly simplified. At the lower operating temperatures and pressures, heat exchanger, reactor, and pressure piping are of lighter construction and lower cost. Sludge is pumped into the system by means of air, and, consequently, the only piece of equipment with moving parts is the air compressor. The unit is designed for automatic and unattended operation, requiring operator attention only during the refilling and restarting period each day. Power recovery has been eliminated as not justified in view of the low power requirements, a unit of one ton (dry weight) per day capacity requires about 50 H.P.

"Water Pollution Control Research —Need for Renewed Effort" was stated by **Frank A. Butrico,** Chief, Office of Resources Development, USPHS, Washington, D. C. Funds, facilities and staff for increased effort in the water pollution control research field must increase by at least ten times in the next decade. The research effort must also be redirected in view of findings by recent committees and conference groups. It was noted that much money is being spent on refinements of existing procedures with very little attention being given to new problem areas. Communication in the scientific community must be improved in order to promote exchange of information and to avoid unnecessary duplication.

"Garbage, Detergents and Sewers" were discussed by **Francis R. Bowerman,** Assistant Chief Engineer, Los

Angeles County Sanitation District, Los Angeles, California. Challenging changes have occurred in the last decade in sewage as the result of ground garbage and household detergent addition. These have complicated the measurement of the effects of additional waste materials and sewerage systems. Automatic washing machines and water softening have also complicated the picture. One of the problems include complication of sewage treatment processes and coating of sewer walls. This has indicated a more frequent cleaning of inverted sewer siphons and the development of more efficient skimming devices in sedimentation tanks.

RESEARCH SYMPOSIUM

"The Organic Composition of a Domestic Sewage" was described by **J. V. Runter** and **Dr. H. Heukelekain**, Rutgers University, New Brunswick, N. J. Results of the analysis of domestic sewages collected during two sampling periods, during the winter-spring 1959, and fall-winter of 1959-60. Sample collection was made on the basis of a 24-hour composite, and the schedule was arranged so that each day of the week was given equal representation. Samples were divided into three particulate fractions and a soluble fraction, through sedimentation, centrifugation, membrane filtration, and lypholyzation. The fractions were examined for content using common strength parameters, and losses of certain of these during processing was estimated. On the basis of further examination, it was found that the settleable fraction contained the greatest percentage of carbohydrates and the supracollodial the greatest percentage of nitrogenous matter. The soluble fraction organic matter was found to be mainly amino acids, sugars, and fatty acids (including detergents). Small quantities of organic bases, phenols, sterols, and other organic materials were also found.

"Composition of Volatile Solids Accumulating in an Activated Sludge System" was described by **Dr. Donald R. Washington**, Asst. Professor, Environmental Engineering, Rensselear Polytechnic Institute, Troy, New York; and **Dr. James M. Symons**, Asst. Professor, Sanitary Engineering, Massachusetts Institute of Technology, Cambridge, Mass. At equilibrium, activated sludge systems operating on long aeration period and given daily loadings will contain on the average the maximum weight of micro-organisms, which can sustain themselves on a given substrate. There has been considerable agreement as to the inevitable accumulation of volatile solids in activated sludge operating at equilibrium. This research was designed to confirm, under controlled experimental conditions, this accumulation to show that this material is biologically inert, and to determine the composition of these volatile solids.

At the loading studied, 40 lb COD per day 1000 cu ft of total basin capacity, it was found that all activated sludge systems, independent of substrate or loading schedule, will accumulate organic sludge solids. At equilibrium, systems fed carbohydrate or fatty acid wastes were observed to accumulate approximately ten percent of the ultimate BOD of the substrate removed as volatile sludge. Since nitrogen derivatives composed a substantial portion of the sludge accumulated at equilibrium in all systems studied, it was concluded that no activated sludge system can be maintained without the addition of some available nitrogen in excess of that removed in the effluent from the system.

"Arginine, Cystine, and Glycine Utilization by Activated Sludge" was discussed by **Dale A. Carlson**, Associate Professor, Civil Engineering, University of Washington, Seattle, Wash.; and **Dr. Lawrence B. Polkowski**, Professor, Sanitary Engineering, State University of Iowa, Iowa City, Iowa. The utilization of specific substances by biological cultures requires that the cultures possess the necessary enzyme and permease systems. The substrate depletion rate is a function of the ability of these systems to adapt to the specific substrate substance provided other factors are not limiting.

Culture response to amino acids was measured by oxygen uptake using the Warburg respirometer. Depletion of free amino acids was followed by paper chromatography.

Oxygen uptake rates in cultures acclimated to L-cystine were three to four times higher than in unacclimated cultures. At lower Concentrations of L-arginine, unacclimated cultures yielded about the same oxygen uptake rates as acclimated cultures, but at L-arginine Concentrations of 1250 mg/l, a two-hour lag period was required for the unacclimated culture to build the necessary enzyme system for oxygen utilization rates approaching those of acclimated cultures. Chromatographic studies indicated glycine depletion in the activated sludge supernatant is enhanced by culture acclimation. Constant rate depletion occurred in acclimated but not in unacclimated culture systems.

Robert C. Merz, Professor of Civil Engineering, University of Southern California, Los Angeles, Calif., was

WITH THE ENTERTAINERS: William N. Konrad, chairman of the local arrangements committee (left); William Sivyer, chairman of the entertainment committee (center left); an unknown woman (right center); and Mrs. Sivyer, on the arrangements committee (2nd from right).

senior author of "Chromatographic Assay of Extracellular Products of Algal Metabolism" with co-authors **John R. Klima,** Dept. of Biology, University of Washington, Seattle, Wash.; and **Dr. Raymond G. Zehnpfenning,** Verdugo Laboratories, Tujunga, Calif.

An investigation was conducted to isolate and identify by genus the algae characteristics of certain sewage lagoons and oxidation ponds. The objective was to determine the nature of soluble organic products produced by 23 species of green algae in pure culture on inorganic media, as well as to compare their characteristics with algae obtained from other sources.

The selection of algae and media was described as well as the laboratory procedure followed leading to the production, isolation, and identification of the soluble extra-cellular by-product of algal metabolism.

"Analysis of the Economics of Sewage Treatment" was discussed by **John A. Logan,** Chairman, Civil Engineering Department, Northwestern University, Evanston, Ill.; **W. D. Hatfield,** Consultant, Decatur, Ill.; **George S. Russell,** Chairman of the Board, Russell and Axon, St. Louis, Mo.; **Walter R. Lynn,** Technological Institute, Northwestern University, Evanston, Ill. New techniques of systems analysis make it possible to analyze and make preliminary designs of sanitary engineering structures using unit costs and unit efficiencies as an integral part of the design, a method which offers distinct advantages over the conventional design followed by costing or price tagging. Direct design requires, in addition to a workable mathematical model of the treatment process, costs and efficiencies; the paper deals only with this latter problem.

While there is a considerable volume of data available on the overall costs on sewage treatment, generally this has not been analyzed on the basis of unit costs or unit efficiencies.

Plant data suffer from the influence of local conditions, ranging from topography to labor costs. To overcome this objection a series of "standard plants" have been designed (for the St. Louis area) and these have been thoroughly analyzed on a cost and efficiency basis; this provides a needed basis of reference for the field data and are presented for comparative purposes.

Both the theoretical and the observed data are presented in a form which makes it directly usable for design purposes, and will be so used in the program now being developed at Northwestern University for analysis on their IBM 709 Digital Computer.

"Enterovirus Distribution in Sewage During 1959 Des Moines Poliomyelitis Epidemic" was discussed by **John S. Wiley,** Technical Development Laboratory; **Tom D. Y. Chin,** Assistant Chief Epidemiology Branch; **Clifton R. Gravelle,** Epidemiology Branch, Communicable Disease Center, U. S. Public Health Service. Twelve sets of sewage samples, each from eight areas, yielded a 53.7 percent recovery of poliovirus Type I. The gauze pad sampling procedure is simple and practical. The Type I poliovirus recovery rates from sewage were 17 times greater than those from two stool surveys involving over 3½ times as many samples. Recovery rates from sewage samples were on a par with those from the laboratory examinations (feces and throat washings) of the patients having hospital admission diagnoses of poliomyelitis. In addition, the sewage samples also revealed the presence of several strains of Type III poliovirus and of ECHO virus.

The sewage sampling technique, with subsequent careful sample preparation, culturing, and isolation procedures, proved extremely valuable in the epidemiologic study of the Des Moines epidemic. Indications are that the methods are sufficiently sensitive to be useful not only in studying an enterovirus epidemic but also in a year-round surveillance program.

Lindsey Becomes Manufacturers' Representative

Ray Lindsey, formerly with B-I-F Industries, has started his own company in Prairie Village, Kansas, as a Manufacturers' Representative.

With a well-rounded background in engineering, Lindsey established his company in August. He offers a Bachelor Civil Engineering degree and graduate work, as well as naval engineering, municipal facilities design and construction, and sales engineering jobs as background.

Lindsey is a registered professional engineer in Minnesota and Kansas, and a member of the American Society of Civil Engineers, the National and Missouri Society of Professional Engineers, the American Water Works Association, the Water Pollution Control Federation and the Kansas City Engineers Club.

He lives with his wife in Prairie Village, Kansas, P.O. Box 9224.

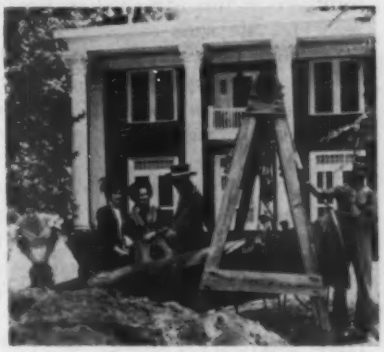
New Greenleaf Engineers in Miami

John W. Greenleaf, Jr. has teamed up with B. A. McAdams to open a consulting engineering office under the name of Greenleaf Engineers, at 1393 S. W. 1st St., Miami 35, Fla.

Both men were formerly associated with Rader and Associates, Greenleaf as a partner and McAdams as project manager. The new firm will give personal service to clients throughout the area of previous activities.

Augusta Mains a Century Old

Playing the role of his predecessor of a century ago, Grover Cushman, superintendent of water construction for Augusta, Ga., stars in a reenactment of the laying of the city's first cast iron water mains, Nov. 4, 1859.



A section of 100-year-old pipe was "laid" in front of a home typical of the ante-bellum South while Augustan belles, also dressed for the period, looked on.

Augusta was introduced as the 118th member of the Century Club of the Cast Iron Pipe Research Association. Members have water or gas mains still in use which were installed more than 100 years ago.

Editorial

Public Health Service Gets Administrative Support

An announcement of considerable potential importance to the future of the national water supply and water pollution control program was made in mid-November. Abraham Ribicoff, Secretary of Health, Education, and Welfare, announced that an Assistant Secretary, James M. Quigley, would be his immediate administrative representative to serve in this important area.

While those who are outside of the organizational machinery can only guess, it appears as though Secretary Ribicoff has listened hard and long, paid attention to some of the suggestions of his predecessors, and, perhaps most important, moved with positive action.

It appears that control of the water supply and water pollution control program has not been taken completely from the Public Health Service. Mr. Quigley has been assigned to work directly with the Division of Water Supply and Water Pollution Control in the Bureau of State Services of the PHS. Again, to an outsider, this provides evidence that Secretary Ribicoff, and the administration, listened carefully to the Public Health Service people before he made his move.

Those who have been dissatisfied with PHS performance in this area will be disappointed. Those who recognize the wide range of experience, both technical and administrative, built up in the PHS over the years, will no doubt applaud the move. For our part, we can only observe that the PHS has been given a renewed opportunity, apparently with every confidence, to pick up the pieces and get going.

It is to be hoped that some of the flaws in previous plans have been detected by the PHS during the months prior to the Secretary's decision. It follows that steps should be taken now to correct the past deficiencies, whether in personnel, programs, or policies.

Secretary Ribicoff also apparently agrees with former HEW Secretary Fleming, who told the 1960 National Conference on Water Pollution that:

"There is no question in my mind that additional progress (in the water supply and water pollution control program) will be made, and I am confident that a move to pull it out of the Public Health Service would retard, rather than accelerate, this progress."

Having made his decision to add the administrative weight of HEW behind the effort, Secretary Ribicoff has solved the dilemma by compromise. If, as workers in PHS and the former Secretary believe, PHS has the steam and the drive to "accelerate this progress", we should begin seeing results before too long.

The assignment of top-level administrative talent to this task carries with it a certain degree of political risk. On the one hand, failure of the program to be as effective as formerly, plus the failure to accelerate, could be politically disastrous. On the other hand, opportunities for pork barreling and other constituent gimmicks might become more difficult to resist. This latter is perhaps, to the nation, the area in which particular attention must be paid to avoid degradation and dilution of the program.

Take, for example, the allocation of funds under the amended Water Pollution Control Act. Thus far, allocation and expenditure of funds have been carried out with only minor, if any, criticism. The expenditures made to date have resulted in pollution abatement works construction, which has bitten out a large chunk of the backlog. Future funds, if made available in accordance with the current schedule, should help to nearly equal the estimated $600 million annual requirement. The program must be continued in areas of project and economic need, not in localities where votes are needed or monuments will look impressive.

V. W. Langworthy

News of Suppliers

Edward E. Alt Retires

Edward E. Alt, one of the nation's leading authorities on elevated water storage tanks, retired on July 31 after 43 years of service with Chicago Bridge & Iron Company, world steel plate fabricating and construction firm. He has been retained by the company in a consulting capacity.

During his active CB&I career, Mr. Alt sold several thousand large steel tanks to municipalities and industrial firms. His name became synonomous with elevated structures for the storage of water and led to his sobriquet of "Mr. Water Tower" throughout the industry.

He has been recognized as a leader in state and national professional organizations in the water supply field for many years. In 1956, he was presented the coveted George Warren Fuller Award by the American Water Works Association for ". . . outstanding service to the Illinois section . . . and his exemplary conduct as a manufacturer's representative."

McCormack Directs New Permutit Offices in Dallas

The Permutit Company, a division of Pfaudler Permutit Inc., manufacturers of water and waste treatment equipment and materials, has announced the establishment of a new industrial sales office at 3603 Lemmon Avenue, Dallas, Texas, under the direction of Austin F. McCormack.

Mr. McCormack has had extensive experience in water conditioning equipment sales for Permutit from 1946 until 1959 and again recently when he rejoined the company to begin operations in the Dallas territory.

American Vitrified Purchases Lehman Sewer Pipe Co.

American Vitrified Products Company, Cleveland, Ohio, one of the nation's largest producers of clay and concrete pipe and kindred materials has announced a series of moves aimed at strengthening their East Coast sales organization.

Jack L. Brown, Vice President and General Sales Manager, revealed the purchase of the Lehman Sewer Pipe Co. of New York City. At the same time he also announced the bolstering of the Eastern Marketing Division by the addition of six men to cover this territory.

These moves follow the completion and full production start-up of American Vitrified's new multi-million dollar plant located at Somerville, New Jersey.

Lehman Sewer Pipe Company is one of the nation's largest clay pipe distributing companies. It has operated in the New York area for over 55 years. Lehman will now become a wholly-owned subsidiary of American Vitrified. A. R. D'Aleo, who headed Lehman, will continue in this capacity.

American Vitrified has 13 plants and regional offices in eight cities.

K&M Plant Manager Post to R. E. Lander

Richard E. Lander, assistant manager of Plant 8, Keasbey & Mattison Company's asbestos-cement pipe manufacturing facility, Ambler, Pa., has been appointed to the position of plant manager, it was announced by E. J. Buczkowski, K&M Vice-President of Production.

Lander has been associated with K&M as a research engineer since 1959. In that capacity, he participated in a number of important projects, the most prominent among them the development and fabrication of the roof sections for the research model home of the Asbestos-Cement Products Association at Oklahoma City.

A member of the National Society of Professional Engineers, and the American Society of Civil Engineers, Lander holds a degree in Civil Engineering.

A. O. Smith Appoints W. M. Asher Vertical Pump Motor Sales Manager

W. M. Asher has been appointed to a newly created sales management position, responsible for marketing vertical pump motors, within A. O. Smith Corporation's Electric Motor Division, Tipp City, Ohio.

Asher first entered the vertical turbine pump field in 1936 as a sales engineer for a well drilling contractor in Plainview, Texas. He joined A. O. Smith's Hydraulic Products Division in 1952, serving first as district sales manager in Houston and later as division general sales manager in Los Angeles. From there, he served four years in South Africa as resident manager of the firm's international operation.

Lipps Appointed Crane Co. Marketing Director

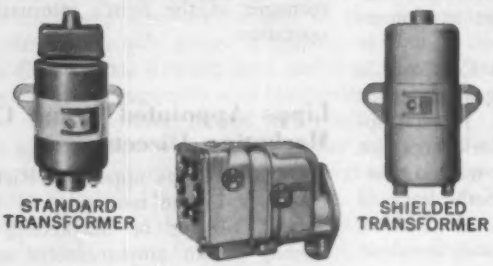
Crane Co. has appointed Richard C. Lipps to the new post of Corporate Director of Marketing, according to an announcement made by D. C. Fabiani, Executive Vice President of the Company.

Mr. Lipps will formulate overall marketing policy and coordinate marketing functions for all Crane operations in the United States. He will also be responsible for the Corporate advertising program of the Company. Crane Co. manufactures flow control products and plumbing, heating and air conditioning equipment in 27 plants located throughout the United States.

Bailey Meter Appoints Mays North Central Regional Manager

Vice President L. F. Richardson, Bailey Meter, annonuced the appointment of G. R. Mays as manager of the company's north central region. This region covers the territory of the Chicago, Cincinnati, Cleveland, Detroit, Milwaukee, and St. Paul districts. Mays, who was formerly manager of the Chicago District, will retain his hedaquarters in Chicago.

IMPROVE ENGINE DEPENDABILITY!
CUT MAINTENANCE COSTS!
NEW FAIRBANKS-MORSE
LOW TENSION IGNITION
...FOR GAS OR GASOLINE ENGINES



STANDARD TRANSFORMER
SHIELDED TRANSFORMER
TYPE FM-LTR LOW TENSION MAGNETO

Best on the market because

- Increases engine life!
- Cuts maintenance and operating costs
- Simplified construction
- Standard flange or base mounting
- Offered in standard and heavy duty models
- Offered with semi-low tension adaptation

This new F-M development gives a positive intense spark. Ozone and high corona discharge do not occur . . . eliminating "green corrosion"; promotes more complete combustion . . . requires far less engine maintenance, fewer spares.

For further details, write: R. D. Hisey; Magneto and Engine Accessories Division; Fairbanks, Morse & Co.; Beloit, Wisconsin.

FAIRBANKS MORSE
A MAJOR INDUSTRIAL COMPONENT OF
FAIRBANKS WHITNEY

Meetings

WHAT WHEN WHERE

1961

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1962

Jan. 15-16—Cincinnati, Ohio (*Robert A. Taft Sanitary Engineering Center*) Short Course: "Basic Radiological Health." This course will be repeated at the Sanitary Engineering Center Apr. 23-May 4; at Southwestern Radiological Health Laboratory, Las Vegas, Nevada, Feb. 26-Mar. 9; and at Radiological Health Laboratory, Rockville, Maryland, May 7-18. Write: Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, or to PHS Regional Office.

Jan. 23—New York, N. Y. (*Statler-Hilton Hotel*) NEW YORK SECTION AWWA Luncheon Meeting. Secy., Kimball Blanchard, Neptune Meter Co., 2222 Jackson Ave., Long Island City.

Feb. 7-9—Indianapolis, Indiana (*Sheraton-Lincoln Hotel*). INDIANA SECTION AWWA. Secy., Chester H. Canham, State Board of Health, 1330 W. Michigan St., Indianapolis 7.

Feb. 13-14—Chicago, Ill. (*LaSalle Hotel*) THE AQUATIC WEED CONTROL SOCIETY. Write: Paul W. Eller, c/o Chipman Chemical Co., Inc., 608 S. Dearborn St., Chicago 5, Ill.

Feb. 15—Newark, N. J. (*Hotel Essex House*) WINTER MEETING NEW JERSEY SECTION AWWA. Write: A. F. Pleibel, Secy., 683 Prospect St., Maplewood, N. J.

Feb. 26-Mar. 9—Cincinnati, Ohio (*Robert A. Taft Sanitary Engineering Center*) Training Course: "Water Quality Management." Sponsored by Public Health Service. Write: Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio, or to PHS Regional Office.

Mar. 15—Boston, Mass. (*Statler Hotel*) NEW ENGLAND SECTION *AWWA*. Secy., Ralph M. Soule, San Engr., State Dept. of Public Health, 511 State House, Boston, Mass.

March 28-30—Chicago, Ill. (*Sheraton Towers Hotel*) ILLINOIS SECTION AWWA. Secy., D. W. Johnson, 3440 Prudential Plaza, Chicago 1, Ill.

Apr. 5-7—Bozeman, Montana. MONTANA SECTION AWWA. Secy., A. W. Clarkson, Div. of Environmental Sanitation, State Board of Health, Helena.

Apr. 5-7—San Diego, California (*Hotel El Cortez*) PACIFIC SOUTHWEST COUNCIL CONVENTION AMERICAN SOCIETY OF CIVIL ENGINEERS.

Apr. 11-12—Albany, N. Y. (*Manger DeWitt Clinton Hotel*) NEW YORK SECTION AWWA. Secy., Kimball Blanchard, Neptune Meter Co., 2222 Jackson Ave., Long Island City.

Apr. 12-13—Morgantown, West Virginia (*Hotel Morgan*) WEST VIRGINIA SECTION AWWA. Secy., Thomas J. Blair, Kelley, Gidley, Staub, Inc., 5418 Mac Corkle Ave., S. W., Charleston.

Apr. 15-18—Jekyll Island, Ga. (*Wanderer Resort Motel*) SOUTHEASTERN SECTION AWWA. Secy., N. M. deJarnette, Robert & Co. Assocs., 96 Poplar St., N. W., Atlanta, Ga.

Apr. 19-20—Chapel Hill, North Carolina (*University of North Carolina*) ELEVENTH SOUTHERN MUNICIPAL & INDUSTRIAL WASTE CONFERENCE. Sponsored by Duke University, North Carolina State College, University of North Carolina. Write: Dept. of Sanitary Engineering, University of North Carolina, Box 899, Chapel Hill, North Carolina.

Apr. 27—Yosemite Valley, Calif. (*Ahwahnee Hotel*) CALIFORNIA SECTION AWWA. Secy., Frank F. Watters, Hydr. Engr., Public Utils. Com., State Bldg., Civic Center, San Francisco.

Apr. 29-May 3—Toronto, Ontario, CANADIAN SECTION AWWA. Secy., A. E. Berry, 72 Grenville St., Toronto, Ont.

May 2-4—Wichita, Kansas (*Lassen Hotel*) KANSAS SECTION AWWA. Secy., F. Harry McBride, Sls., Engr., B-I-F Industries, 2108 W. 75th St., Prairie Village.

May 2-4—Wichita, Kansas (*Lassen Hotel*) KANSAS SEWAGE AND INDUSTRIAL WASTES ASSN. Write: Howard F. Saiger, 1900 E. Ninth, Wichita, Kansas.

May 3-5—Tucson, Arizona (*Pioneer Hotel*) ARIZONA SEWAGE AND WATER WORKS ASSN. AND ARIZONA SECTION AWWA. Secy., A. D. Cox, Jr., Secy. & Comptroller, Arizona Water Co., Box 5347, Phoenix.

May 21-23—Traverse City, Michigan (*Park Place Hotel*) MICHIGAN SEWAGE AND INDUSTRIAL WASTES ASSN. Secy., D. M. Pierce, Michigan Dept. of Health, Admin. Bldg., Lansing 4, Michigan.

May 30-June 2—Seattle, Washington (*Olympic Hotel*) PACIFIC NORTHWEST SECTION AWWA. Secy., Fred D. Jones, W. 2108 Maxwell Ave., Spokane, Washington.

June 10-15—Washington, D. C. INTER-AMERICAN ASSN. OF SANITARY ENGINEERING (AIDIS). Write: 1962 AIDIS Congress, Office of Public Health, Washington 25, D. C.

June 20-22—Duluth, Minnesota (*Hotel Duluth*) CENTRAL STATES SEWAGE AND INDUSTRIAL WASTES ASSN. Secy., Scott E. Linsley, 2400 Childs Rd., St. Paul 6, Minn.

Aug. 20-25—Madison, Wisconsin (*University of Wisconsin*) 15TH INTERNATIONAL CONGRESS OF LIMNOLOGY. Write: The 15th International Congress of Limnology, c/o Dr. John C. Wright, Birge Hall, University of Wis., Madison 6.

Aug. 26-29—Denver, Colorado. AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Includes Symposium on Treatment and Disposal of Waste from Uranium Mining and Milling Operations.

Sept. 3-7—London, England. FIRST INTERNATIONAL CONFERENCE ON WATER POLLUTION RESEARCH. Write: Prof. W. W. Eckenfelder, Jr., Manhattan College Environmental Engineering Research Laboratory, 514 Sylvan Ave., Englewood Cliffs, N. J.

Simplified by Simplex: New Float in Flume meter measures with great accuracy the flow of various kinds of liquids in channels, sewers and other gravity flow systems – and radically slashes construction costs.

New "Float in Flume" obsoletes the stilling well – saves you its construction cost

Now you can measure open channel or sewer line flow accurately without a stilling well – but at a fraction of the construction, installation and maintenance costs.

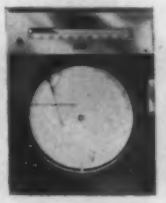
The "Float in Flume" is simplicity itself. A vane, floating atop the liquid passing through the flume, senses the liquid level. This data is transmitted through a Simplex transmitter-receiver system (pneumatic or electric), and is translated into flow terms on a modern, easy to read Simplex type "L" meter.

You save all the costs formerly required by a stilling well: the extra excavation and concrete, float pipe, grating, valves, drain pipe and fittings, cleaning valve and sediment chamber.

You don't even need a purging system. An occasional wiping of the vane is all the cleaning required.

The Float in Flume transmitter may be installed in existing flumes or is furnished assembled with a Simplex Type "S" Parabolic Flume as shown above.

Before you install another meter requiring a stilling well, check the savings of the Float in Flume meter. Drop us a note today and ask for Bulletins 726 and 728.



Simplified by Simplex: New Type "L" Meter is more modern, more compact. Big red-and-white helical indicator replaces pointer, makes reading easier. Continuous type totalizer unsurpassed for accuracy. All parts are mounted on swing-out panel for easy servicing.

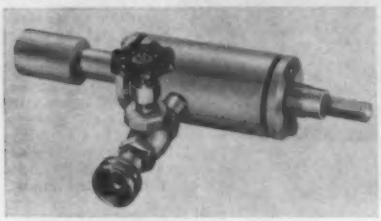
SIMPLEX® VALVE AND METER CO.
LANCASTER, PENNSYLVANIA
a division of
PFAUDLER PERMUTIT INC.

Equipment News

CONTINUED FROM PAGE 20A

Hydromechanical Earth Auger

Designed for easier installation of smaller types of underground pipelines—water, gas, conduits, sewers, sprinkler systems, etc.—Borit eliminates trenching, tunneling, backfilling, surface repairs, and unsightly, costly damage to lawns, landscaping,

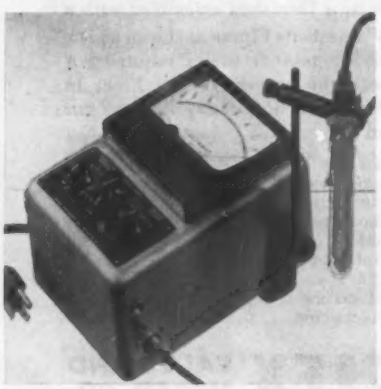


trees, walks and streets. A hydromechanical earth auger, it operates on the principle of combining the natural action of water erosion with positive control of mechanical drilling, at boring speeds of 350 to 450 rpm; bores horizontally, vertically or at any angle. Borit works effectively in dirt, sandy loam, clay shale and certain gravels and hardpan, cutting roots as it goes, for distances up to 60 feet. It is power-driven by standard electric or pneumatic drill with ½ inch or larger chuck.—Borit Sales Co.

Circle No. 1220 on Reader Service Card

Portable pH Meter Features Millivolt Scale

New ELECTRION II line-operated portable pH meter features a +500 millivolt scale and a unique,



full-range shock-resistant combination electrode, according to the manufacturer.

Standard features include: constant-reading meter; amplifier-stabilized, drift-free indicator needle; reference pointer; easily connected solid ground (usually found only on larger, more expensive units); fast-response tubes which require no "breaking-in" time; 115V line operation (leave in continuous service to eliminate warm-up time, give instant reference and constant pH readings).—The Meaker Co.

Circle No. 1221 on Reader Service Card

Vibrating Screens

The availability of a new unit, called the Series 500 Vibrating Screen, has been announced by this manufacturer. Designed especially for lighter-duty screening requirements in chemicals, minerals, food products, agricultural commodities, for sizing, scalping, and de-watering applications, the Series 500 features a unitized vibrator cartridge, easy amplitude adjustment, 98 percent vibration isolation, push-type tapered bearing removal sleeves, and double piston ring grease seals.—Overstrom & Sons, Inc.

Circle No. 1222 on Reader Service Card

Sewage Disposal Plant Maintenance

Lubricants offered by this manufacturer will help solve many Sewage Disposal Plants lubrication problems.

McLube 1181, for use on grit conveyors and mechanical bar screens, is an anti-seizing grease compound that is virtually impervious to sewage water and sewage contaminants so that effective lubrication is possible with this product even under the severe conditions involved in these applications.

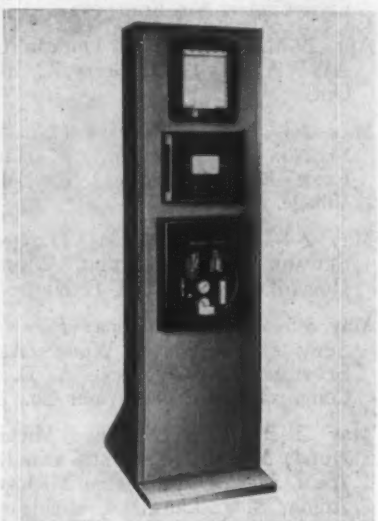
McLube 711 is an anti-seizing extreme pressure lubricant that has excellent penetrating property. It has proven highly effective for freeing valves that have tightened up from sludge, and it serves also to prevent subsequent build-up and seizure of the valves. A specific use is on plain bearings and bushings of bar screens and grit conveyor drives and idler wheels; also, on teeth and cones of comminutors to facilitate removal.

McLube 533 is a dry film lubricant that does not contain any oil or grease whatever, and therefore will not attract dust or dirt. It is excellent for the lubrication of moving parts in recording and control instruments. It is a fluid with excellent penetrating property. It is best applied with a dropper of some type.—McGee Chemical Co., Inc.

Circle No. 1223 on Reader Service Card

New Dissolved Oxygen Analyzer

The development and production of a new precision instrument, the DO-100 Continuous Dissolved-oxygen Analyzer, has recently been an-



nounced by this manufacturer. The new analyzer accurately and continuously measures and records micro quantities of dissolved oxygen in boiler and other high-purity-water systems. The instrument is electrochemical and direct-acting in operation. An uncomplicated hydraulic system and straightforward, printed circuits mean compactness, reliable operation, and easy maintenance.

Dissolved-oxygen reacts with measuring electrodes in a sampling cell. An electric current proportional to the amount of oxygen in a continuous sample is generated. This current operates an indicator (calibrated 0 to 25 or 0 to 230 parts per billion) from which a signal may be transmitted to any standard millivolt recorder.

Precise control of sample-water flow, temperature, and conductivity assures readings accurate to ± 5% of full scale. An oxygen change as small as 0.1 parts per billion regis-

ters within 5 to 10 seconds after the sample enters the instrument.— Wallace & Tiernan Inc.

Circle No. 1224 on Reader Service Card

Compact Pumping Unit

A compact pumping unit maintaining constant head at variable volume is now available to replace conventional incremental pumps in sewage lift applications and to augment or replace gravity storage reservoirs in water systems. Designed for municipal or industrial use, the unit provides a cost-saving approach to new service installations, and to expansion of existing services. Named "System Pressure Computer Controller", it combines high efficiency pumps with electric drive having infinitely variable speed. Control derives from a transistorized computer that accepts pressure input signals and converts to electronic signals that govern pump performance.—MacDonald Associates Inc.

Circle No. 1225 on Reader Service Card

Portable Air Tank

A low cost, lightweight portable air tank for a wide variety of compressed air applications is now available from this manufacturer. The new portable air tank is just two feet long and one foot in diameter. Rated at 100 psi working pressure (300 psi hydrostatic test), it is equipped with a pressure gauge indicating 0 to 160 psi with safety valve pre-set at 150 psi. The unit comes complete with six-foot air hose, chuck and quick disconnect coupling, and air valve which permits easy refilling from any air source.

The portable air tank is used by well drillers, pump installers, contractors, farmers, service station operators and home owners.—Medalist Tank Div., Metal Coating Corp.

Circle No. 1226 on Reader Service Card

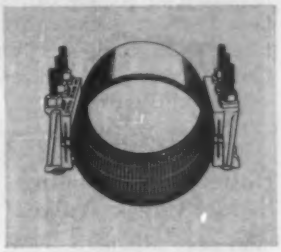
When a pipe breaks or springs a leak,

FIX IT AND FORGET IT

—for the life of the pipe!

No need to remind you that in most instances the major cost of repairing most pipe leaks involves locating, exposing and refill. You know this. Smith-Blair knows it, too! That is why every Smith-Blair product is engineered and manufactured to assure a *permanent* repair. A Smith-Blair repair unit properly selected and installed, will last for the remaining life of the pipe!

For example, Smith-Blair Full Circle Clamp Couplings.



These are designed to reconnect full breaks, repair holes, cracks and other damage in all types and sizes of pipe.

Permanence of repair with a wide margin of safety is assured by Smith-Blair design features that permit uniform pressure seal over 360°. These features are 1) tapered and finely gridded gasket; 2) recessed armor.

These Smith-Blair features, together with other data that will help you, are described in new Bulletin 1263. We will be glad to mail you a copy, without cost.

VALUABLE DATA YOU SHOULD HAVE

Smith-Blair manufactures a complete line for every pipe O.D. requirement. Check items that interest you, mail coupon today.

- ☐ Full Circle clamp couplings
- ☐ Taper-Seal service saddles
- ☐ Cast couplings
- ☐ Flanged coupling adapters
- ☐ Pipe repair clamps
- ☐ Compression couplings
- ☐ Steel couplings
- ☐ Tapping saddles; sleeves
- ☐ Fast-Action clamp couplings
- ☐ Expansion joints
- ☐ Meter couplings
- ☐ Pipe end caps

All of these from one, dependable source.

SMITH BLAIR

Smith-Blair, Inc.

535 Railroad Avenue, South San Francisco, Calif.
W. Newton Rd., Greensburg, Pa.
5635 E. Imperial Hwy., South Gate, Calif.
300 Waco St., Texarkana, Texas

—suppliers in all principal cities.

New Literature

AVAILABLE FREE

Null Balance Recorders and Recording Controllers

12-page brochure GEA-6887A describes General Electric's complete line of single and multi-pen null balance recorders and recorder-controllers. Also discussed are multi-point recorders and multi-purpose indicators. Descriptions of typical measurements performed by the recorders and controllers are outlined in a special section. The illustrated bulletin contains information on features, dimensions, specifications, optional accessories and applications. —General Electric Co.

Circle No. 1227 on Reader Service Card

Bulletin on Darling Swing Check Valves

24-page Bulletin No. 6102 on Darling 50 Line Swing Check Valves in regular and increasing types is now available. This illustrated bulletin describes how the revolving double disc principle, a feature of Darling Gate Valves, has

been adapted to swing check valves.

Darling 50 Line Swing Check Valves incorporate all applicable features of AWWA and Federal specifications and are in accord with Underwriters and Factory Mutual Specifications.

The bulletin includes a pressure rating table on the 2-to-16 inch valve sizes, as well as construction details.—Darling Valve & Mfg. Co.

Circle No. 1228 on Reader Service Card

Rubber Sheet Packing Line Described in New J-M Folder

A new Rubber Sheet Packing brochure, published by Johns-Manville, describes the complete line of these materials. Included in the brochure, PK-170A, are a considerable number of natural and synthetic rubber sheet packings recently added to the product line.

Of a total of 15 rubber sheet packings described, there are three new styles in natural rubber, a new Neoprene diaphragm sheet, two new Neoprene sheets, and two new Nitrile sheets.

The brochure covers general purpose sheet, diaphragm sheet, Neoprene sheet, and Nitrile sheet styles. Complete data are given for each product, including its construction, recommended applications, ASTM and MIL specifications met by the packing, Durometer hardness, and temperature and pressure services. —Johns-Manville.

Circle No. 1229 on Reader Service Card

Gasoline Powered Boring Unit

The Ka-Mo G-16, a gasoline powered earth boring unit for drilling 2¾ to 12 in. holes, is the subject of a new 4-page bulletin released by the Kwik-Mix Co.

The bulletin describes and illustrates the G-16 in detail. Included in the description are these performance advantages: compact for tight-quarter work; fast and easy set-up; self-contained to eliminate auxiliary power source; and choice of manual or power forward feed. —Kwik-Mix Co.

Circle No. 1230 on Reader Service Card

Type M Precipitator Bulletin

A six-page folder recently issued presents the new Permutit Type M Precipitator, a unique sludge-blanket clarifier whose agitator arms are driven by water jets at the tips.

The bulletin describes fully in illustrations and text the operation and design of the new solids contact precipitator. Operating graphs, based on field experience, show the Type M's quick accomodation to changes in raw water makeup, plus the results of a salt tracer detention test. —The Permutit Div., Pfaudler Permutit Inc.

Circle No. 1231 on Reader Service Card

A New Concept in Water Treatment Plant Design and Control

B-I-F Industries, Providence, R. I., manufacturers of equipment and systems for positive control of materials flow, announces a new concept in Water Treatment Plant design and control. The Laboratory Control concept, condensing and concentrating years of experience in water filtration and treatment, features the idea of finger tip control over plant throughput, chemical additions and filter backwash from a single console in the laboratory.

The four-page, two-color bulletin just issued shows with illustrations and schematic diagrams how the new console controls the pacing of chemical feeders by flow and automatically controls filter backwash programs through each phase, assuring high quality effluent.—B-I-F Industries.

Circle No. 1232 on Reader Service Card

Literature Package Covers Electric Power Conversion Line

System Analyzer Corporation has made available a complete literature package describing their complete line of equipment which converts single phase to three phase operation without the high cost of three phase wiring.

Specifically, the package includes a covering letter explaining the vast markets available, a reprint of case histories and a brochure explaining the advertising campaign to support the dealer-wholesaler.

Highlighting the package is a 4-page, two-color brochure fully illustrated and diagramed to explain the company's complete power conversion line: Add-A-Phase Power converter; Power-Twin Universal Multi-phase motor; Phase-Shifter Economy Converter.—System Analyzer Corp.

Circle No. 1233 on Reader Service Card

A Better Way to Provide Water for Peak Loads

B-I-F Industries, Providence, Rhode Island, has just issued "It's a Fact" data on the filtration problem of providing water for peak loads. This new data, accompanied by bulletins, arrangements and application data, features B-I-F's Vacuum Filters, Product Class 1860. Selected from its complete line of equipment for water filtration, the Vacuum Filters are ideally suited to answer the problems of water filtration systems caused by peak loads when there is little or no margin available to satisfy requirements and when available space for additional filters is severly limited.—B-I-F Industries.

Circle No. 1234 on Reader Service Card

Literature Available on Water Distillers

A portfolio containing illustrated data sheets describing water distillation equipment is now available from Badger Manufacturing Company. Contents include data sheets with complete descriptions, flow charts and tables of sizes for each of the three types of Badger distillers—vapor compression, flash, and vapor compression forced recirculation. The folio cover, which "packages" the data sheets, includes valuable information on methods of selecting the proper still for sea water conversion or processing applications and a description of the patented Badger Entrainment Separator.—Badger Mfg. Co.

Circle No. 1235 on Reader Service Card

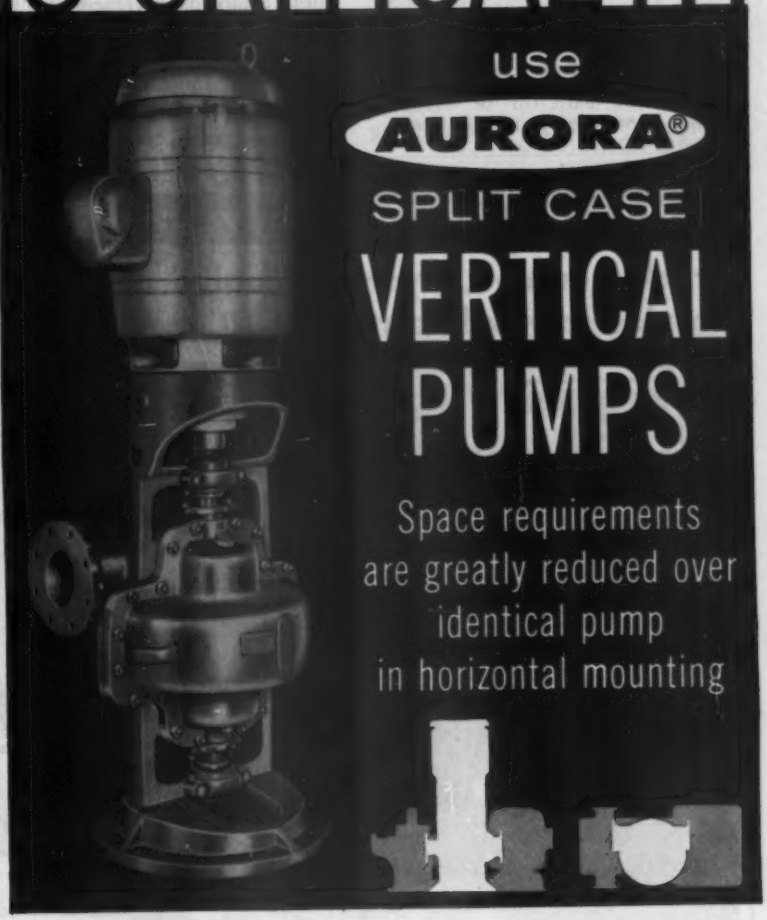
Small Sewage Treatment Plants of Extended Aeration Type

Small sewage treatment plants designed for "modern-day" wastes are presented in Yeomans' new bulletin, No. 1510. Heart of the plant is a "Yeo-Wave" surface aerator that has no moving parts in the aeration tank.

Bulletin lists 10 sizes from 3000 to 18,000 gallons per day as well as application design data on institutional, commercial, small factory, subdivision and municipal use.

CONTINUED ON PAGE 92A

WHERE SPACE IS CRITICAL...



In addition to the substantial reduction in floor space with the vertical base mounting, these pumps have opposed suction and discharge connections which permits rotation of the unit to accommodate simplified piping, saving wall space and reducing installation costs.

All of the easy-accessibility features of the horizontal split case pumps are retained. Simply remove the cover for inspection, adjustment, or removal of the rotating element without disturbing the piping or motor.

Available in single-stage double suction or two-stage opposed suction types. Capacities range up to 6000 GPM and heads to 600 feet with continuous operation.

Write today for free bulletin

AURORA always PUMPS

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
1020 LOUCKS • AURORA, ILLINOIS
LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK

New Literature

CONTINUED FROM PAGE 91A

Cross-section drawings and text explain the construction and operation of a complete small plant. Round or square tanks and manufactured or built-on site variations are supplied.—Yoemans Brothers Co.

Circle No. 1236 on Reader Service Card

New Bulletin Gives Facts on 108 Hooker Chemicals

The 1961 edition of "Hooker Chemicals", a 16-page bulletin listing and describing the firm's 108 organic and inorganic chemicals for industry and agriculture, is now available.

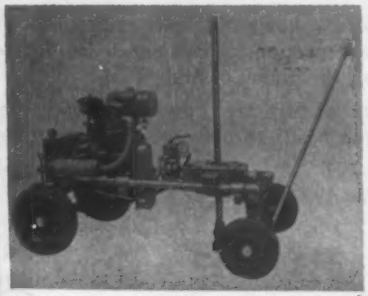
The new quick-reference Bulletin 100-E covers acids and alkalies; the elements chlorine and phosphorous; metallic salts, phosphorus compounds, sulfur compounds, chlorides, chlorobenzenes and other chemicals produced by Hooker's Eastern Chemical, Western Chemical and Phosphorus Divisions.—Hooker Chemical Corp.

Circle No. 1237 on Reader Service Card

Payne Dean & Company, Clinton, Conn.

Truck-mounted, hydraulic valve operators provide fast, safe control of 10" to 60" valves

One Man Control of Speed and Torque on Gate Stem with Indication. Two Safety Control Devices.



4-Speed Electric Motor Gatenders. For Floor-Stand and Under Floor Operation. 1 to 5 HP 10" To 36" Valves.

Portable Engine Driven Gatenders, For Valves 10" to 36". All Hydraulic Operation. Two Safety Features.

New Data-Logger Bulletin

Data-Master® loggers perform two basic functions: 1) accurate, systematic collection of process, test and other operating data and 2) presentation of this data in the most useful form for supervisory, process analysis, research and accounting purposes of for direct input into computers.

A new bulletin (D 401) released by The Bristol Company is written to alert potential users to the economy and application flexibility of Data-Master automatic data loggers. Clear photographs supplement discussion of operating system installations in manufacturing, distribution and process industries.—The Bristol Co.

Circle No. 1238 on Reader Service Card

Factory-Built Sewage Lift Stations and Sewage Treatment Plants

A 16-page product brochure, describing the design features and operation of Smith & Loveless equipment for the sewage and industrial wastes field, has just been released by that manufacturer.

New Bulletin 50 emphasizes the firm's complete line of factory-built sewage pumping stations, pneumatic ejectors, factory-built and field-erected "Oxigest" sewage treatment plants and comminutors.—Smith & Loveless, Division-Union Tank Car Co.

Circle No. 1239 on Reader Service Card

Complete Vari-Tex Speed Changer Line

Design features of the Vari-Tex speed changer that provide dependable low cost variable speed are described in Bulletins 51B9061B and 51B1042 released by Allis-Chalmers.

Available in five case sizes ranging from 1 to 30 hp, the Vari-Tex speed changer provides stepless speed changes within standard speed ranges of 2 to 1 through 10 to 1 at operating speeds from 1.8 to 4660 rpm.

The bulletins tell how a choice of mechanical, electrical and pneumatic control options can afford a wide degree of versatility in measuring process or product variables by means of standard sensing and signalling devices.—Allis-Chalmers Mfg. Co.

Circle No. 1240 on Reader Service Card

Odor Control

A new booklet that describes an inexpensive way to control objectionable odors has been published by this manufacturer.

The 20-page booklet tells how Ozene curbs objectionable odors and their causes—sulfide-forming bacteria and mold micro-organisms. Ozene, because of an emulsifying agent, is able to mix with water thus fully utilizing the properties of orth-dichlorobenzene, normally not water soluble.

A few parts per million of Ozene-Water emulsion has been successful in controlling odors from sewage disposal plants, garbage cans, cesspools, drainage ditches, textile mills, picnic areas and dairy and cheese plants.—Solvay Process Div., Allied Chemical Corp.

Circle No. 1241 on Reader Service Card

Application Guides for Remote Pressure Regulator Control

A series of cost-saving application diagrams showing how to hook-up self-operated regulators to provide economical remote control of steam and water pressure is made available by Spence Engineering Co., Inc.

Six detailed diagrams feature detailed application guides for such typical problems as remote control of manual shut-off, remote shut-off by fluid pressure, electrically operated remote shut-off, remote adjustment of remote-mounted pilot, and remote adjustment for a minimum pressure. Sequence of operation is described and advantages of each hook-up are specified.—Spence Engineering Co., Inc.

Circle No. 1242 on Reader Service Card

"Proof Book" to Aid Builder-Contractor

The Bermico Division of Brown Company has published for builders and contractors a reference and selling aid which contains documentary evidence of Bermico's varied and extensive use in "Life-Guarded" applications that "Outlast a Lifetime", according to Malcolm T. Murray, vice president of the bituminized fibre pipe and conduit division.

Designed to serve two purposes, the "Proof Book", as it is called, reports actual performance data taken from past installations, and provides case histories which illustrate Bermico's varied and long range application in carrying sewage and low pressure liquids underground. The "Proof Book" also points up the product's successful use in carrying corrosive industrial wastes under severe service conditions.—Bermico Div., Brown Co.

Circle No. 1243 on Reader Service Card

Control Valve Catalog

A new 8-page Control Valve catalog DCV-1 is now available from this manufacturer. The catalog shows OPW-Jordan's complete line of Control Valves from ¼ in.-6 in. sizes, metals available including Ductile Iron, Cast Iron, Cast Steel, Stainless Steel, Bronze, Monel, and Aluminum, pressure and temperature ratings, features, capacity charts, names of parts, dimensions, flow chart, diagrams of various hook-ups, simple specifications, information on When To Use A Controller and When To Use A Positioner and a complete explanation of OPW-Jordan's patented Sliding Gate Seat that provides tight shut-off and accurate control because of its self-cleaning self-lapping construction.—OPW-Jordan Corp.

Circle No. 1244 on Reader Service Card

CONTINUED ON PAGE 94A

M&H

Roll-call for water

When Wall Street, N.Y. Was Only a Stone Wall

Middle Atlantic States
New York
New Jersey
Pennsylvania

After the Dutch bought Manhattan Island from the Iroquois Indians, they built a stone wall across the island to prevent possible attack by the English. That military barrier, built 308 years ago, is known today as Wall Street and is the financial center of the United States. Around it stands one of the largest cities in the world!

What a change has taken place in 300 years! This one time wilderness—now three Middle Atlantic States—has become one of the most heavily populated and one of the wealthiest sections of the country. It has great factories and industries, educational institutions, famous pleasure resorts, rich agricultural districts, modern hospitals. It has 85 domestic water distribution systems, each serving 25,000 or more consumers. Some of them are the largest and most modern water works systems in the Nation. But—authorities rate only 40 of them as adequate, 25 as of doubtful adequacy and 20 of them as deficient in capacity!

When an Iroquois Indian needed more water, he just moved his camp. Today's white man must improve his water distribution system to bring more water to him.

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

New Literature

CONTINUED FROM PAGE 93A

Cold Weather Concreting

This 8½ x 11 placard for use on bulletin boards at jobsites, engineer's and contractor's offices, etc., gives in down-to-earth language, informative charts and attractive artwork, the basic do's and don'ts of cold weather concreting.

It gives valuable data on such matters as use of accelerators, preparation of forms and subgrade for placing concrete, and protection and curing. On the back of the placard is a handy nomograph with which you can easily tell just what temperature mix water should be to obtain the desired concrete temperature with your aggregate and cement.—The Master Builders Co.

Circle No. 1245 on Reader Service Card

Holloshaft Pump Motor Manual

To assist users in obtaining optimum operation and longest service life, and to enable pump dealers and maintenance men to save time and needless procedures in installing, inspecting, and servicing its Holloshaft vertical turbine pump motors, U. S. Electrical Motors, Inc. has just published a liberally illustrated and charted Instruction Manual covering its Type HU-Oil-Lubricated motors. Frame sizes 254 UP through 445 UP.

The Instruction Manual outlines in careful, easy-to-understand steps various factory-developed procedures that are designed to minimize the dealer's and maintenance man's servicing efforts. The new manual is divided into three main sections: (1) Installation, (2) Operation, and (3) Maintenance and Repair.—U. S. Electrical Motors Inc.

Circle No. 1246 on Reader Service Card

Coating for Reservoirs Described

"Weathercoat" impervious membrane for water-storage facilities is described in detail in Bulletin B-22, a brochure available from this manufacturer. Featured in the bulletin is a report on construction of the Seneca Reservoir in East Oakland, Calif.

"Weathercoat" is described as a factory-prepared homogeneous mixture of asphaltic emulsion combined with mineral fillers and fiber. After setting, it is said to form a remarkably tough, tenacious coating that is odorless, non-toxic, and moisture proof.

In addition to providing information on the material itself, the bulletin provides detailed data on the construction and water-proofing of the 30-million-gallon Seneca Reservoir. This data covers excavation and subgrade seal, under-drain system, Bitumuls Asphaltic aggregate base, base prime and Weathercoat Impervious Membrane, and concrete surface slab. One section is devoted to answering the question, "How About Costs?"—American Bitumuls & Asphalt Co.

Circle No. 1247 on Reader Service Card

ACCURATE GRAPHIC AND VISUAL REGISTRATION

of liquid flow with

STEVENS

RECORDER TYPE B-FT

Recording, indicating and totalizing meter for measuring sewage or other flows over Parshall flumes and weirs. This instrument has interchangeable flow cams and flow conversion gears... an important factor to consider for sewage treatment plants in rapidly growing communities. With a simple change of cams and gears the Type B-FT Recorder can operate with a different size flume or accommodate a greater range of flow than that for which it was originally purchased. The change does not require factory service. Similarly, change from weekly to daily time scale, or vice versa, is accomplished by merely repositioning one gear — no new parts to buy.

This recorder can be direct float operated or remotely controlled and is available for wall or switchboard mounting, or with cabinet for mounting out of doors directly over the float well. Request BULLETIN 25 for complete details.

STEVENS HYDROGRAPHIC DATA BOOK

Invaluable for your reference file. Contains technical data on recorder installations, plus a wealth of hydraulic and conversion tables. $1 copy. (No COD's)

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DATE

TOTALIZER BEGIN

L&S INSTRUMENTS

LEUPOLD & STEVENS INSTRUMENTS, INC.

4445 N E GLISAN STREET · PORTLAND 13, OREGON

Specialists in hydrologic instruments for over half a century.

New Polypore Membrane Filter Catalog

The Gelman Instrument Company has just published an informative 24-page catalog dealing with their Polypore membrane filter. The catalog describes the unique advantages and applications of this versatile filter in: Air Sampling, Industry, Chemistry, and Biomedicine.

The polypore catalog also contains recommended filtration accessories, filter characteristics comparison table, filter compatibility table, as well as complete price lists for all types of Polypore filters.—Gelman Instrument Co.

Circle No. 1248 on Reader Service Card

Solenoid Valves

Solenoid valves with a new UL listing are shown in Bulletin 710-Q, offered by this manufacturer.

The listing covers Gould Types Q and Q-1 in all seven sizes—⅜, ½, ¾, 1, 1¼, 1½ and 2 in. Models are general purpose, fully automatic, 2-way, packless, normally closed piston-pilot operated with bronze body. Type Q valves are for air, water and steam, while Type Q-1 are for steam only.

The bulletin gives pressure ratings, electrical data, construction details, dimensions, and prices.—J. D. Gould Co.

Circle No. 1249 on Reader Service Card

Dispersives

Custom engineered dispersives formulted to minimize adherent sludge formation in boilers and recirculating cooling systems are discussed in Bulletin HSP-941 now available from this manufacturer. Selection of dispersives based on results of physical and chemical examinations of deposits and samples needed to conduct the examinations are discussed in the bulletin. Several case histories dealing with sludge accumulation problems in various boilers and cooling systems are also discussed.—Water Chemical Sales Div., Hagan Chemicals & Controls, Inc.

Circle No. 1250 on Reader Service Card

Type H Leak Detectors

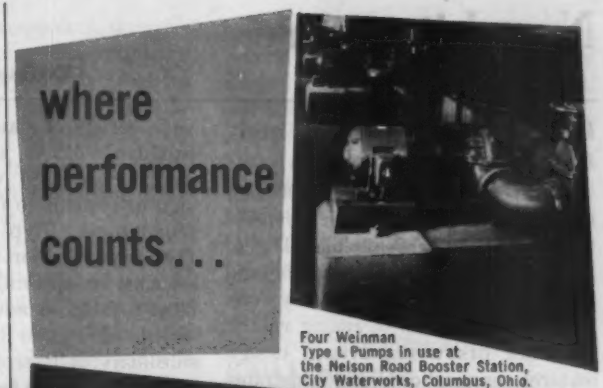
General Electric Bulletin GEA-6817A, eight pages, describes G-E's Type H line of portable, halogen sensitive, electronic leak detectors for industry, research and defense applications. All leak detectors discussed are sensitive enough to precisely locate pressure and vacuum leaks as small as 1 100 cu. in./day. They include: Gun Detector, Type H-2, and Pencil Probe Detector, Type H-5, for inspection of welds, seams, joints, and other suspected areas of leakage in pressure systems; Stationary Detector, Type H-3, for completely automatic production line leak testing, Vacuum Detector, Type H-4, for vacuum system leak checks; and other related General Electric leak detectors.—General Electric Co.

Circle No. 1251 on Reader Service Card

Activated Sludge Plants

Bulletin Ref. H-6139 offers complete information on Yeomans Activated Sludge Plants. It includes basic data for evaluating aeration equipment.—Yeomans Bros. Co.

Circle No. 1252 on Reader Service Card



Four Weinman Type L Pumps in use at the Nelson Road Booster Station, City Waterworks, Columbus, Ohio.

count on WEINMAN PUMPS

You'll find Weinman Pumps first preference in public installations . . . where equipment must stand the test of time and yet have a low initial cost that fits the public purse. Experience has shown cost-conscious officials that they can depend on precision-built, job-proven Weinman Pumps to provide the 'round-the-clock service they need and demand . . . and with just routine maintenance, too.

A favorite pump among engineers is the large capacity . . . up to 4000 g.p.m. . . . Weinman Type L Split Case, Single Stage, Double Suction Pump for low, medium or high (up to 400 feet) head pumping service. Its unusual versatility adapts it to a great number of pumping applications making it of even greater value for city, state and federal uses.

You just can't beat a Weinman Pump for money-saving, dependable public service. It will pay you to consult your Weinman Pump Specialist whenever you have a pumping problem.

For the advice of experience . . . look him up in the Yellow Pages ...or write direct for Bulletin 1200.

THE WEINMAN PUMP MFG. CO.
COLUMBUS 16, OHIO
CENTRIFUGAL SPECIALISTS

New Literature

CONTINUED FROM PAGE 95A

Digital Data Recording and Alarm Scanning System

Comprehensive 8-page, 4-color brochure describes Monitor Systems' Series 7000 line of modular Digital Data Systems for alarm scanning and digital recording of virtually any type or combination of analog values. Brochure discusses system design features, applications, and illustrates wide variety of standard field-proven building blocks and subassemblies available at MSI which permit design of systems to meet virtually any requirement. Typical Series 7000 Data Systems for either low-speed, low-cost monitoring or high-speed, ultra-reliable monitoring are illustrated.—Monitor Systems, Inc., a subsidiary of Epsco, Inc.

Circle No. 1253 on Reader Service Card

CENTRILINE
adds
PERMANENCE
to steel pipelines

Steel has the Strength
Centriline has the Lining

Even before they are put in service, steel pipelines can be **improved** by the Centriline Process. To steel's great strength, durability and flexibility of design, add a smooth, continuous Centrilining of cement-mortar. Corrosion and tuberculation cannot then attack the line. Pressure is maintained, pumping costs stay down, and operating problems are cut to the bone.

Trained Centriline crews and all necessary equipment are spotted strategically across the U.S., Canada and Latin America—ready to work on new pipe or to renovate pipelines **already in place.** Only a very few excavations are needed in this latter process. Our engineers will also help in the design and specification of Centrilined steel pipes.

Because of these advantages and services, many major cities now specify in-place cement-mortar lining—evidence that Centrilining steel pipe (up to 12 feet in diameter) is a good move in the direction of real economies. Send today for our illustrated brochure that covers the entire Centriline process. On special problems, our engineers will be pleased to consult with you at once.

CENTRILINE CORPORATION
A Subsidiary of Raymond International Inc.
140 CEDAR STREET • NEW YORK 6, N. Y. • WOrth 2-1429
Branch Offices in Principal Cities of the United States, Canada and Latin America

Brochure Presents Roots High Vacuum Booster Pumps

Illustrated Bulletin HV-161 presents Roots High Vacuum Booster

Pumps. Units are described as Rotary Positive, two-impeller, dry type compressors designed specifically for use in high vacuum systems for environmental applications and vacuum processing.

Performance features described include: High vacuum with high thruput; pumping speeds to more than 30,000 cfm; extremely wide operating range with "blank-off" pressure below 0.5 microns Hg absolute; high volumetric efficiency, rotary positive displacement with no surging or backstreaming; dry operation with positive sealing; easy adaptability into automated systems; flexibility in choice of driver.

Bulletin includes diagrams showing operation of Roots Rotary Positive Principle, typical applications, pumping speed curves, and compression ratio vs. inlet pressure curves.—Roots-Connersville Blower, Div. of Dresser Industries, Inc.

Circle No. 1254 on Reader Service Card

Pneumatik Tel-O-Set Instrumentation

Three new specifications describe Honeywell's new PneumatiK Tel-O-Set line of instruments to supplement their existing miniature pneumatic instrumentation. The new complete line features automatic switching with no matching of any pressures; simple, accessible zero and damping adjustments; easy-to-read 4-inch charts rectilinear recording, simple, calibrated control adjustments; optional front-set control adjustments; and easy-to-remove components.

Complete details on the features, specifications and ordering information for individual models are available on these specifications.

a) S1004-1—PneumatiK Tel-O-Set Indicators and Recorders without control

b) S1004-2—PneumatiK Tel-O-Set Recording and Indicating Control Stations.
c) S1004-3—PneumatiK Tel-O-Set Recording and Indicating Control Stations for Cascade Control.—Minneapolis-Honeywell Regulator Co.

Circle No. 1255 on Reader Service Card

Lo-Loss Flow Tubes

A new, four-page bulletin describing the numerous types of Penn Lo-Loss Flow Tubes is now available. Versatility of applications as well as unique performance features are discussed. Comparative performance curves, capacity tables, photographs and cut-away views are illustrated.—The Penn Meter Co., formerly Penn Instruments Division of Burgess-Manning Co.

Circle No. 1256 on Reader Service Card

Strip-Scale Receiver

The Series 654 Metagraphic® Pneumatic Receiver is a strip-scale indicating receiver which can be used as a single unit or gang assembled for either horizontal or vertical mounting. The instrument saves panel space and permits simultaneous indication of coordinated variables.

A new Product Data (No. A113.1.3-10) released by the manufacturer discusses applications for the instrument and provides engineering drawings of construction, design and size.—The Bristol Co.

Circle No. 1257 on Reader Service Card

Sewage Treatment Chemicals

A new line of sewage treatment chemicals has just been announced. Included are a variety of products designed not only for municipal sewage treatment plants, but also for operators of waste disposal facilities in private subdivisions, industrial developments and military bases.

Entitled "The Brulin Line of Sewage Treatment Chemicals", this six-page, two-color brochure presents six products for use in sewage control.

BIO-ZYME is an enzyme mixture in powder form for liquefaction of solid sewage both at the treatment site and in the sanitary line.

DE-ODOR 3600 is a water-dilutable concentrate for odor control at sewage and industrial waste treatment sites.

S. C. #550 is a heat and alkaline action liberating compound intended for use in private and municipal waste disposal lines for clearing roots, leaves and grease accumulations.

Brulin's DEFOAMER #250 is advocated for control of foam in activated sludge plants.

D & M CONCENTRATE is announced as a new insecticide for control of psychoda (filter) flies, found around the edges of trickling filter sewage treatment plants.—Brulin & Company, Inc.

Circle No. 1258 on Reader Service Card

Ion Exchange Materials

Analytical Grade Ion Exchange Resins (anion, cation, mixed bed, and special resins), "CELLEX" Ion Exchange Celluloses, and Pre-Calibrated Resins, all specially prepared for use by research, analytical and pharmaceutical workers who are concerned with accurate, reproduceable ion exchange techniques free from resin-introduced impurities are described in the latest publication available from this manufacturer.—BIO-RAD Laboratories.

Circle No. 1259 on Reader Service Card

CONTINUED ON PAGE 98A

1952
1953
1954
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1960 1961

an example of
NICHOLS HERRESHOFF
Dependability...

9½ YEARS OF NON-STOP OPERATION

In February 1952 a NICHOLS HERRESHOFF FURNACE was placed on line burning undigested sewage solids. After eighty-three thousand hours of continuous duty, more than one and a half billion pounds of sludge cake had been burned to a sterile ash. THIS IS DEPENDABILITY.

The first sludge burning furnace in the world —a NICHOLS HERRESHOFF—is still on the job at age 27 years. THIS IS DEPENDABILITY.

If you are interested in dependability like this and in low cost and complete disposal of all sewage solids—write us today for a copy of our illustrated Brochure 238-A with further information.

NICHOLS ENGINEERING & RESEARCH CORP.
60 Pine Street, New York 5, New York
3513 N. Harvey Street, Indianapolis 18, Ind. • 1336 North Carolan Ave., Burlingame, Calif.

LET US SOLVE YOUR INDUSTRIAL WASTE PROBLEM

Today's modern industries and processes often create industrial waste problems that can actually stall profit-making applications of new discoveries.

Naturally enough, communities feel that public health comes first, and some industrial wastes and acids may eat up sewer lines fast.

At Crystal Lake, Illinois, the Clay Pipe industry has built a modern new research and testing laboratory. Experimentation is constantly going on to test pipe and jointing materials to see which is actually the best under all conditions for sanitary and industrial wastes.

Tests show that Vitrified Clay Pipe with its new resilient self-sealing joints is impervious to the corrosive action of sanitary sewerage and industrial wastes and acids which normally flow through sewer lines.

But yours may be a special problem. Let us help you with it. Write, outlining the problem to be tested, to:

National Clay Pipe Manufacturers, Inc.
1028 Connecticut Ave., Washington, D. C.

COMPRESSION SEALED, VITRIFIED
CLAY PIPE
IMPERVIOUS
THE STANDARD for SANITARY SEWERS

NATIONAL CLAY PIPE MANUFACTURERS, INC.
1028 Connecticut Ave., Washington, D. C.
Please send me full details on the new factory-made compression joints on Clay Pipe.

(name)
(company)
(street address)
(city and state) B-813 WS

New Literature

CONTINUED FROM PAGE 97A

Orifices

Bulletin #100 describing orifices and orifice assemblies is offered by this manufacturer. Data for proper selection and application, cut-away views and photographs are featured in this publication.—The Penn Meter Co., formerly Penn Instruments Division of Burgess-Manning Co.

Circle No. 1260 on Reader Service Card

Cascade Control from Storage Level

Cascade control instrumentation for a typical water filter plant is the subject of Application Bulletin 90-49-16 by Fischer & Porter.

The new four-page publication describes the operation of a system designed to maintain full storage facilities by matching plant capacity to consumer demand, thus making an extra supply of finished water available at all times.

Instrument requirements to provide control are listed in the bulletin. and the role of each in the system is illustrated by means of a simple line drawing.—Fischer & Porter Co.

Circle No. 1261 on Reader Service Card

Rubber Seated Gate Valves

A new 8-page, 2-color Bulletin 302 is now available describing DeZurik rubber seated gate valves. The bulletin lists features of the valve as well as materials, dimensions, actuators, and outlines the broad areas where the valve is extensively used.—DeZurik Corp.

Circle No. 1262 on Reader Service Card

Large Diameter Plastic Sewer Pipe Included in Federal Specification

Plastic sewer pipe in 8, 10 and 12-inch diameters has been included in a Federal Specification for sanitary and storm sewers. Recognition of this specification now provides two officially recognized national standards for use by consulting engineers and municipalities in specifying plastic pipe on sewer projects.

A recent re-issue was made of Commercial Standard CS 228-61 on

SPECIFY SUTORBILT 3200 SERIES BLOWERS FOR SEWAGE TREATMENT PLANTS

Rugged Sutorbilt rotary positive-pressure blowers reduce maintenance, cut replacement costs, and assure a high level of performance. They deliver 800 to 23,000 cfm at pressures from 2 to 12 psig. Available with timing gear diameters from 10" through 26" in horizontal designs. Many sizes also offered in vertical case arrangements. Ideal for aeration of grit chambers, channel aeration, pre-aeration flotation, flocculation, tank aeration, air lifts, gas recirculation.

Design Features

TWO-PIECE, impeller case strongly ribbed to prevent distortion

ONE-PIECE 4140 forged steel shaft, slip-fitted through impellers, attached at gear ends, allowing increased pressures and horsepower rating with complete safety

OVERSIZED ROLLER BEARINGS, in cartridges for easy removal

HELICAL ALLOY STEEL TIMING GEARS, piloted to shaft and bolted to timing hub

CLOSE-GRAIN CAST IRON IMPELLERS, precision bored to receive shaft

MACHINED SUB-BASES as standard equipment

LUBRICATION by force-feed pressure system

Write for detailed specifications on the versatile Sutorbilt Blowers. Dept. H.

Sales representatives in principal cities

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SUTORBILT CORPORATION
IS WELL BUILT

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Subsidiary of Fuller Company • Catasauqua, Pa.

Plastic Drain and Sewer Pipe, which also incorporates the 8-inch through 12-inch sizes. Provision for including the plastic pipe was covered by Amendment - II to Interim Federal Specification WW-P-00380 (GSA-FSS) entitled Pipe, Drain and Sewer, Plastic. Copies of these Specifications on plastic pipe are available.—Evanite Plastic Co.

Circle No. 1263 on Reader Service Card

Flow Nozzles

Four-page Bulletin #201, describing Penn's wide line of Flow Nozzles has been published. Cut-away illustrations, photographs, performance curves and application engineering data are included.—The Penn Meter Co., formerly Penn Instruments Division of Burgess Manning Co.

Circle No. 1264 on Reader Service Card

Economical Hook-Ups of Air-Control Regulators

Application engineering for cost-saving, efficient use of air-control pressure regulators is published in guide sheets by Spence Engineering Co., Inc. Hook-up diagrams, recommended installation and steam capacity tables are included in the publication.

How to obtain the most efficient steam use for an absorption refrigeration machine with an air-control pressure regulator is clearly described. Another guide shows how to provide remote control of a regulator, without consuming air, rerouting main piping or adding special air piping.—Spence Engineering Co., Inc.

Circle No. 1265 on Reader Service Card

Pump Selector Guide

"When You Buy Your Pump" is a useful guide to the selection of pumps for water supply or booster service in industry, commercial buildings and municipal water works. Starting out with a description of the factors to consider in selecting any pump, the booklet compares various types of pumps, including submersibles for deep well service. A comparison checklist is also included to aid in the selection of the most desirable features of submersible pumps.—Sumo Pumps, Inc.

Circle No. 1266 on Reader Service Card

CONTINUED ON PAGE 100A

MALLEABLE IRON or

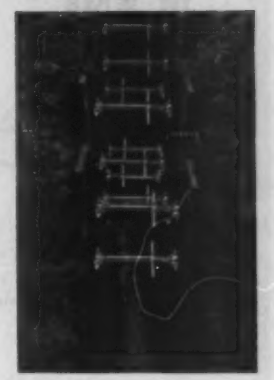
DROP FORGED?

Rugged dependability suggests that you insist on the best — Simplex *drop forged steel* trench braces.

Ball and socket joints at each end for tight grip at any angle. Blunt lever nuts or 3-way nuts — nail holes in both screw and butt ends. Furnished with or without pipe.

Simplex drop forged steel trench and timber braces *cost no more* and better eliminate the danger of cave-ins and costly re-digging.

SEND FOR MECHANICAL JACK CATALOG



WORLD'S LARGEST MFGRS. OF INDUSTRIAL MECHANICAL AND HYDRAULIC JACKS

SIMPLEX JACKS

RE-MO-TROL JENNY UTIL-A-TROL SOL-TOE

TEMPLETON, KENLY & COMPANY
2569 Gardner Road
Broadview, Illinois

Before you buy any storage tank...

take a look at

No matter what your storage problem, a prestressed concrete tank offers many immediate and long term advantages. Minimum maintenance, longest service life, lowest overall cost, 75% of construction cost is spent locally. Modern in engineering and design, proven in service, lowest in cost...prestressed concrete should be considered in any tank planning.

Send for your copy of our new brochure "Prestressed Concrete Tanks."

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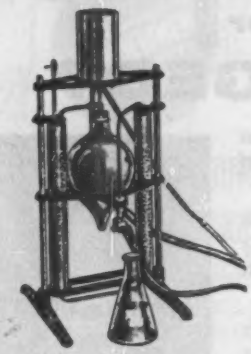

For checking the equilibrium of a finished water, and supplying an index useful in controlling anti-corrosion treatment. Catalog No. 83-895

WRITE:

Phipps & Bird, Inc.

P. O. Box 2V Richmond 5, Va.

New Literature

CONTINUED FROM PAGE 99A

Bulletin on Complete Line of Vertical, Enclosed-Shaft, Non-Clog Pumps

A new approach in bulletin layout and content is used by Chicago Pump in Bulletin 124-G to introduce its complete line of vertical, enclosed-shaft, non-clog VCS pumps.

These pumps are designed for sewage, sump or storm water service in institutional, industrial, municipal and commercial applications with capacities from 50 to 5000 gpm and heads to 105 feet.

Bulletin #124-G has been planned for the busy design and layout engineer, as it systematically and in sufficient detail, describes a simple method for determining non-clog pump head and capacities. Followed in logical order are easy to use pump and motor selection tables; preliminary layout dimension data on the pumps, basins and basin covers; engineer specifications; illustrated details of the necessary controlling devices, optional equipment and installations.—Chicago Pump Div., Food Machinery & Chemical Corp.

Circle No. 1267 on Reader Service Card

Solenoid Valve for Raw Water System Intake Control

A new 2-way, cylinder operated, solenoid valve for raw water system intake control is now available. This Bulletin 8338 valve controls flushing water to rotary screens for filtering debris from rivers and ponds at the inlet to water purifying and pumping stations. Its "Y" type body configuration provides flow almost equal to a straight-through, gate-type valve. It is capable of handling dirty water that has been coarse filtered only. Operation is directly off the main line pressure, requiring no auxiliary pressure source. The valve is supplied in 2 in., 2½ in. and 3 in. N. P. T. sizes—Automatic Switch Co.

Circle No. 1268 on Reader Service Card

High Pressure Solenoid Valve

A new 2-way high-pressure solenoid valve, especially suited for hydraulic applications, is now available from this manufacturer. Of

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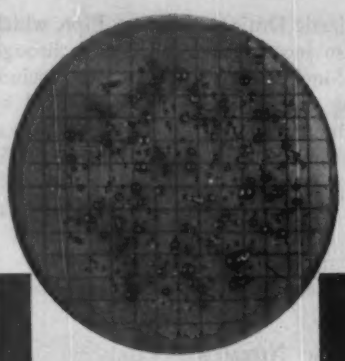

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The City of Philadelphia needs a high level research man to supervise projects investigating water treatment processes, algae control, removal of organic compounds, etc. Requires a degree in civil, chemical or sanitary engineering or chemistry or biochemistry plus 5 years professional water purification experience, one year as supervisor. Salary starts $8464. Regular increases. Liberal fringe benefits. Write to J. F. Weiss, Room 792, City Hall, Philadelphia 7, Penna.

The City of Fort Worth Water Department has position openings for four graduate engineers, one Civil Engineer I and one Civil Engineer II for office designs, research and field construction of sanitary sewers, one Civil Engineer II or III as Resident Engineer on a large expansion of a sewage treatment plant and one Chemical Engineer II to supervise industrial waste studies. Engineers II and III must have professional engineer qualifications. For further information on the positions, experience and educational requirements and salaries, contact the Personnel Director, City of Fort Worth, Texas.

normally open construction (valve is open when solenoid is de-energized), this valve operates at pressures to 1000 psi air, and 850 psi water and light oil. Supplied in ½ in. N. P. T. pipe size, with brass body and integral seat, and composition disc.

This ASCO Bulletin 8223 valve is available with either General Purpose, Watertight or Explosion-Proof solenoid enclosures and may be mounted in any position without affecting operation.—Automatic Switch Co.

Circle No. 1269 on Reader Service Card

CONTINUED ON PAGE 102A

DIRECTOR OF PUBLIC WORKS CITY ENGINEER

The City of Bloomington, Minnesota (population 54,000) is accepting applications for the position of Director of Public Works—City Engineer. Applicants must be registered Civil Engineers with at least five years' experience in Public Works and Engineering. Starting salary $9,000 to $12,500 depending on experience.

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City of Bloomington
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New Literature

CONTINUED FROM PAGE 101A

Speedomax Recorders for Gas Chromatography

A new two-page Data Sheet E-ND46(9) describing Speedomax G and H Recorders for laboratory gas chromatography applications is now available.

The features of the Speedomax G strip-chart recorder are discussed and applications where a precise, flexible and versatile instrument is required, are given. Complete specifications are provided. They include: two switch-selected ranges of 1 and 5 millivolts; continuously adjustable span and zero dials; a one-second balancing time; a dead band of 0.15 percent on all ranges; and an external impedance of as high as 10,000 ohms.—Leeds & Northrup Co.

Circle No. 1272 on Reader Service Card

Constant Pressure Pumping System

4-page Bulletin EF-250A illustrates and describes the EVER-FLO, a new Constant Pressure Pumping System for industrial, commercial and residential buildings offered by this manufacturer.

The EVER-FLO uses a variable speed coupling which accelerates or decelerates the pump speed to meet requirements of the system. The motor operates at a constant speed and the pressure control is connected to the building riser. The variation in demand governs the out-put speed of the drive and the capacity developed by the pump, thus maintaining a constant pressure. The EVER-FLO system is a complete package consisting of pump, motor, drive coupling and control.—Weil Pump Co.

Circle No. 1273 on Reader Service Card

Valve Remote Control Design Manual

Stow Mfg. Co., Inc. has just published a new Design Manual 618 covering their complete line of manual remote controls as used on ships and in power plants, chemical plants nuclear power plants and industrial plants for valve. Included are dimensional sketches of all terminals.

This manual is divided into 3 sections. Section (1) covers flexible shafting; Section (2) covers standard rigid reach rod controls and Section (3) covers gear boxes including a 90° gear box and the new 300° swivel geared joint; also, information is given for selecting the correct size and type components for making an installation on any valve up to those with 27-inch diameter handwheels as well as special materials for non-magnetic or other requirements.—Stow Mfg. Co., Inc.

Circle No. 1274 on Reader Service Card

Increased Ouput for Aeroil Space Heaters

A substantial increase in BTU output is the big feature of the new Aeroil space heater line. The HE-S-140 oil fired heater offers a 15,000 BTU per hour increase over the 1960 model. The new heater provides 140,000 BTU per hour. Fuel consumption is approximately 1 gallon per hour.

The HE-S-325 provides 325,000 BTU per hour—a 75,000 BTU increase over the comparable 1960 model. Other new high-output Aeroil space heaters include the 500,000 BTU oil fired heater, 100,000 and 200,000 BTU LPG fired heaters, a 220,000 BTU natural gas heater and a 550,000 BTU LP Liquid heater.—Aeroil Products Co., Inc.

Circle No. 1275 on Reader Service Card

Brochure Describes Cenco Lab-Jack

Complete information and details on the Cenco-Lerner Lab-Jack are contained in a new six-page illustrated brochure just published.

The Lab-Jack is a light-weight, fully adjustable laboratory support which can be used for a wide range of laboratory tasks. Its applications range from raising heavy oil baths, heaters or burners under mounted flasks to positioning radiation detection devices for precise measurements. The Lab-Jack is also used in simplifying setups with expensive glassware, drying columns and condensers.—Central Scientific Co.

Circle No. 1276 on Reader Service Card

Bulletin on New Differential Pressure Gauge

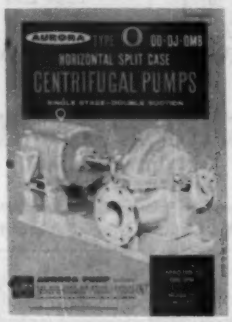
A new differential pressure gauge is described in Bulletin E10, available from this manufacturer. The bulletin contains specifications, drawings and ordering information.

The gauge it describes is a leak-proof model operating by a magnetic coupling. It is designed for indicating up to 60 psid in systems up to 3000 psi.—Pall Corporation.

Circle No. 1277 on Reader Service Card

Split-Case Centrifugal Pumps

New 8-page Bulletin 105C illustrates and describes the complete line of Single-Stage, Double Suction, Horizontal Split Case Pumps available from this manufacturer. It also contains sectional photos, selection charts, dimensional data, limitations



chart, and engineers-architects specifications. Features include: suction and discharge connections in bottom half of case, removal of rotating element without disturbing piping, unusually short bearing centers, scientifically balanced impellers keyed and screw-locked in position, and pressure-seated bronze case wearing rings. Capacities range up to 6000 gpm, heads to 380 feet.—Aurora Pump Div., The New York Air Brake Co.

Circle No. 1278 on Reader Service Card

Aerator Performance Studies

Basic data now available (Bulletin Ref. H-6139) allow comparison between Hi-Cone's "efficiency rating" and other aeration equipment. The ease with which Hi-Cone Surface Aerator handles variations in waste flows and strength through easily adjustable weirs and variable operating speeds is explained in detail.—Yeomans Bros. Co.

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DURCO anodes are widely applied for the cathodic protection of many types of equipment employed in fresh water services. Some of these applications include fresh water storage tanks, filter tanks, rake arms in sediment basins, pipelines, and many other applications.

Definite cost savings can be realized with a permanent cathodic protection system using DURCO anodes. For latest data and case histories, write for Bulletin DA/7.

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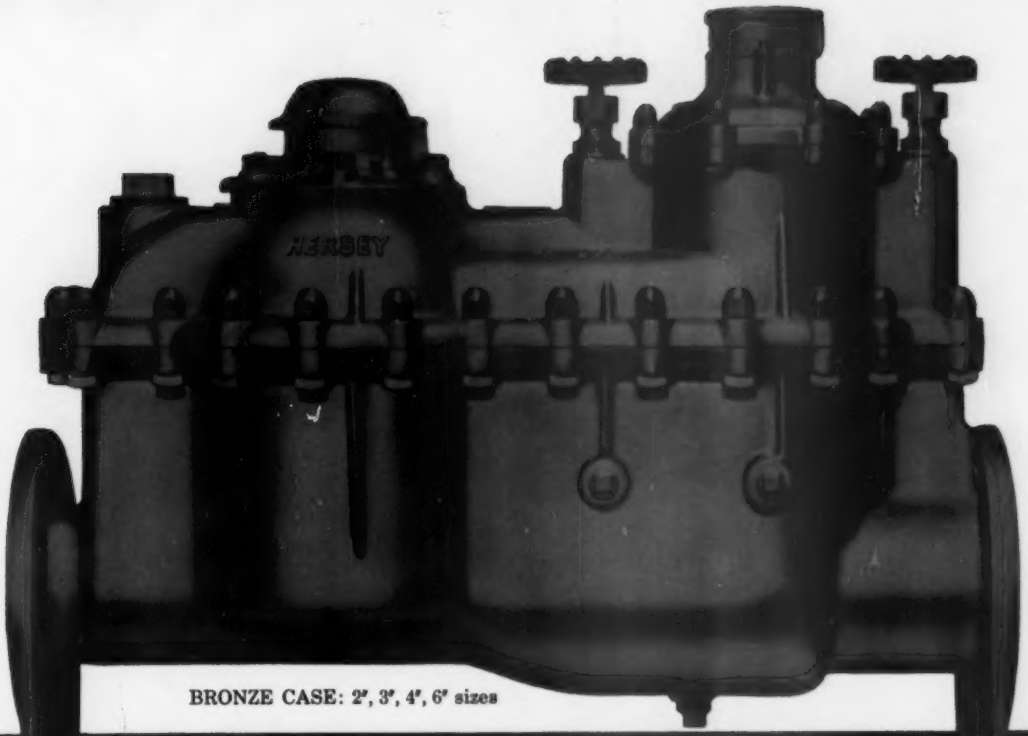

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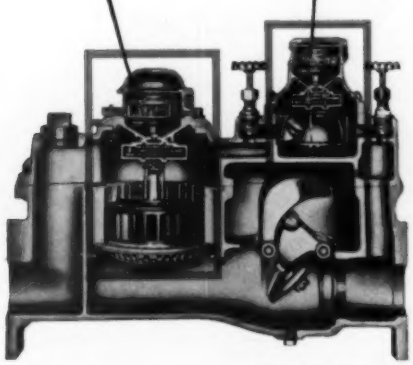

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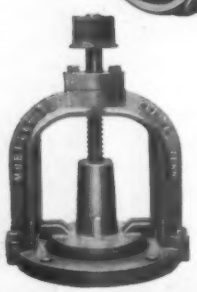

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